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Volume 2 — Number 12

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

DECEMBER 1932

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•

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NEWTON D. BAKER, CHAIRMAN
NATIONAL CITIZENS' COMMITTEE

WELFARE AND RELIEF MOBILIZATION, 1932

Among Our Writers

SAMUEL P. WETHERILL, JR., was born in Philadelphia and obtained his education at the University of Pennsylvania. Colonel Wetherill has always been active in civic betterments for his native city and its surrounding territory. He is president of the Wetherill-Morris Engineering Company.

WILLIAM H. CONNELL became in 1912 Chief Engineer of the Philadelphia Highway Department, later serving successively the Philadelphia Rapid Transit Commission and the Pennsylvania State Highway Department. He has been Executive Director of the Philadelphia Regional Planning Federation since 1929.

HENRY J. SHERMAN maintains consulting offices in Camden, N.J. He has been engaged on such important works in New Jersey as the construction of inland waterways, beach protection, port development, state boundary relocation, and toll bridge construction.

ALBAN P. SHAW, after being employed for a few years in municipal engineering by Atlantic City, entered the employ of New Castle County, Del., serving as County Engineer since 1930. He is secretary of the New Castle County Regional Planning Commission.

JOHN P. HOGAN has specialized in the investigation, design, construction, valuation, and management of water-supply and hydro-electric projects for many years. He is chairman of the Society's Committee on a Normal Program for Public Works Construction.

MALCOLM PIRNIE'S practice is in the design, construction, and operation of water and sewerage works. He is president of the Metropolitan Section of the Society and a member of the executive committee of the National Committee for Trade Recovery.

FREDERICK H. MCDONALD has been active in engineering-economics and financial fields for many years and has made several thoughtful proposals for economic stabilization.

ELISHA LEE, now Vice-President of the Pennsylvania Railroad, has given continuous service to that railroad for forty years.

C. G. WIGLEY was formerly Chief Engineer of New Jersey's Board of Health. Since 1919 he has maintained a consulting sanitary engineering practice in Atlantic City.

HARRISON P. EDDY, JR., has received his engineering experience in connection with water and sewage practice, and in recent years more particularly in the field of garbage and rubbish collection and disposal.

E. P. ARNESON soon after graduation spent 1½ years in Spain on the Ebro Irrigation and Power Project, Barcelona. He has maintained engineering offices in San Antonio, Tex., for the past 16 years.

RUSSELL VAN NEST BLACK was a member of the special commission which in 1922 made complete plans for the new town of American Falls, Idaho, required by the construction of the American Falls Dam of the Bureau of Reclamation.

HARRY M. FREEBURN is a graduate sanitary engineer of Pennsylvania State College. Since 1925 he has had charge of the Philadelphia Office, Bureau of Engineering, State Department of Health.

THOMAS R. AGG has been engaged upon problems of highway economics for many years. For nearly 10 years Dean Agg was chairman of the Committee on Economic Theory of the Highway Research Board.

GEORGE W. FULLER began his career as a water supply and sanitary expert with that eminent authority, the late Rudolf Hering. Mr. Fuller's firm designed the Ward's Island Sewage Treatment Plant now under construction in New York City.

J. L. BAUER was County Engineer of Union County, N.J., for over 27 years. In 1929 he was appointed State Highway Engineer of New Jersey.

BURTON W. MARSH, a specialist in traffic control, for 6 years was traffic engineer for Pittsburgh, and since 1930 has filled a similar position in Philadelphia.

HOWARD T. CRITCHLOW, between 1924 and 1929, was in charge of the investigation of groundwater supplies for the State of New Jersey in the Department of Conservation and Development. For the past 3 years he has been on the State Water Policy Commission.

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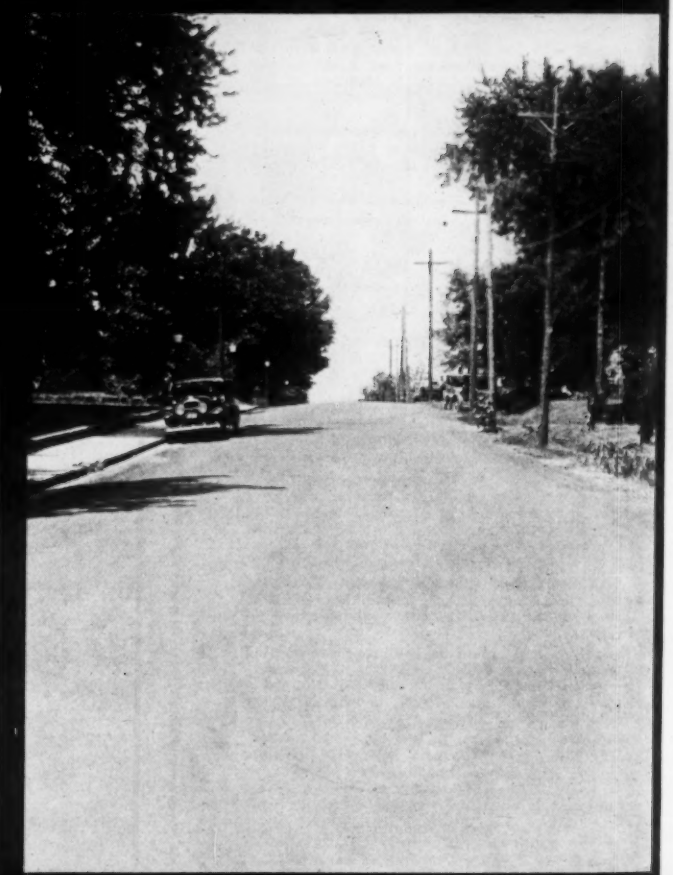

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DECEMBER 1932

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VOLUME 2

NUMBER 12

The Regional Plan for the Philadelphia Tri-State District

Covering an Area of Nearly Three Million Acres

ONE of the nation's most comprehensive regional plans has been completed by the Regional Planning Federation of the Philadelphia Tri-State District, an area of 4,500 square miles in 11 counties of three states, supporting a population of about 3,500,000 people. Organized in 1923, the Federation has not only convinced the taxpayers and voters of the region of the value of orderly planning, but also has inspired industrial and civic leaders and the residents of the communities in the area to support the movement to the extent of $600,000. With this fund the plan has been brought to its present state. It stands as a guide for the development of the area.

In this symposium, which has been prepared from papers presented on October 5, 1932, before the Atlantic City Meeting of the Society, Colonel Wetherill outlines the purposes behind the movement and the development of the idea; Mr. Connell describes the methods used in making the regional plan and publishing it in the form of a 600-page bound volume; Mr. Sherman deals with details of the planning of that part of the district in New Jersey; and Mr. Shaw describes the similar coordinated efforts that have been made in Delaware.

Development of the Movement

By SAMUEL P. WETHERILL, JR.

FORMER PRESIDENT OF THE REGIONAL PLANNING FEDERATION OF THE PHILADELPHIA TRI-STATE DISTRICT

IN the Philadelphia Tri-State District the early impetus to regional planning was due to the vision of three outstanding financial and industrial statesmen, men of broad viewpoint: Samuel Rea, late president of the Pennsylvania Railroad; Samuel T. Bodine, late chairman of the board, United Gas Improvement Company, Philadelphia; and Effingham B. Morris, chairman of the board of the Girard Trust Company, Philadelphia. They knew that industry and finance could not be wisely administered without recourse to a definite budget and a definite plan of what ought to be done, as well as of what ought not to be done. When their support of regional planning was asked, they gave it without reservation, indicating with conviction that municipalities, as well as industries and financial institutions, should have a plan in accordance with which they could decide upon future capital outlays for the region. The story of regional planning is not complete without recognition of the vision of those men.

It is necessary for the public to know not only that the highest type of leadership in the community is putting its shoulder to the task of analyzing what is needed, but also that there is representative sponsorship of the program. There must be, in addition, a will on the part of the people in general to support the conclusions arrived at by representative leaders. Assurance by leaders of the necessity for a plan would avail little if, when projects on the plan came to a popular vote entailing the expenditure of public funds, the municipal, state, county, or local authorities could find no informed constituency to press for the adoption of a sound program.

In the Tri-State District we decided not only to seek the sponsorship of the expert, but also to invoke the support, the confidence, and the voting power of the residents of the entire area. At the conclusion of the first period of regional planning, which included the five years from 1923 to 1928, no doubt remained in the mind of anyone that the region wanted planning and that it wanted the benefit of a concerted, coordinated plan. Citizens and business and civic interests subscribed more than $600,000 to make the Regional Plan. Public officials came to realize that their constituencies wanted them to dedicate themselves to a comprehensive and orderly program, and not to a haphazard one.

How was it possible that Federation speakers could go before rotary clubs, chambers of commerce, and all kinds of groups in the entire region, and convey to their members that the theory of a well-made plan was something that they should advocate? It was difficult because it seemed an abstraction to such groups. It was an idealist's dream. Yet by pictorial presentation and by clean-cut definition of what it was and what it was not, the idea of comprehensive planning was driven home. True, it was in times of comparative prosperity.

Now, in these times of depression, it is my belief that

the need for the plan is greater than ever before. The need for an intelligent engineering approach to the problem of expenditure of public moneys is greater than ever before. The policy of the Society, in advocating national policies with reference to the expenditure of public moneys for public construction indicates that the members, as citizens and engineers, recognize that the public has to understand what its problems are. If the Society gets behind this message, the public can and the public will understand it.

There are extremists who say that not one dollar of capital should be spent now. There are extremists, on the other side, who say that all the money we can get our hands on should be spent, regardless of the amount of indebtedness involved. Both sets of extremists are overstating cases. As a result of five years of personal contact throughout the Philadelphia Region with just those types of people, we know that the public can be sold on a middle-ground program, nationally as well as regionally.

To engineers, the collection of significant data on which to base engineering judgment is quite commonplace, but the collection of such data is not the rule among municipalities. The balancing of municipal budgets and the reduction of taxes in ensuing years will be accomplished in direct proportion as the populace can be made to see that conformity to wise plans must be the guide both in making and in refusing to make public appropriations. We are in the midst of a crisis. The way to come out of it successfully is through the intelligent application of business principles to public problems, and through the conservation of public funds by conformity with previously determined plans instead of haphazard log rolling or other hit-or-miss methods.

There are innumerable indirect or invisible applications of the planning principle to public problems. Let me give you a single instance of the application of planning to the national defense—by no means, of course, the major objective in the preparation of a plan. Recently, after I had presented a paper on the military significance of regional planning, a major general of the U.S. Army rose and said to the assembled officers: "Gentlemen, if the plan outlined to you for the Philadelphia Tri-State District is accomplished, it will be possible for 25 per cent of the number of soldiers necessary to defend this area without that plan, to defend it adequately with that plan." That was an interesting dollars-and-cents figure for the taxpayer.

Regional planning is one of the greatest assets of the American public today. City planning and community planning, of course, are essential to the detailed execution of the over-all plan. The Regional Planning Federation has made available an example of cooperative planning, of minds meeting minds, of interests meeting interests, and of agreement upon acceptable compromise solutions, all looking to the social and economic betterment of a region containing more than 3,500,000 inhabitants. We in the Philadelphia Tri-State District believe we have given to the country an example of the fact that it is possible—and practical—to apply business methods to public affairs and that the people will back the effort.

Making the Plan and Writing the Report

By WILLIAM H. CONNELL
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
EXECUTIVE DIRECTOR, REGIONAL PLANNING FEDERATION, PHILADELPHIA TRI-STATE DISTRICT, PHILADELPHIA

ENCOURAGED by public sentiment favorable to the idea of making a comprehensive regional plan of the metropolitan area of Philadelphia, the Regional Planning Federation came into being in 1924. This body proceeded with the necessary preliminary investigations to determine a basis for developing a regional plan and operated under a modest budget until a procedure and a probable cost were agreed upon. During 1928, business and civic organizations raised over $600,000 to cover the cost of preparing a comprehensive regional plan for the Tri-State District.

The first technical activities of the Regional Planning Federation were the collecting and assembling of all available maps and statistical data of value in showing the conditions existing throughout the Philadelphia Tri-State District. A circle of approximately 30 miles radius was tentatively accepted as representing the region to be studied. This area on its northeastern periphery included Trenton and on its southwestern, Wilmington; when enlarged and squared up for convenience in mapping, it became a rectangular tract of about 3,850 square miles.

This early concept of the Tri-State region was subsequently modified by common consent, and the region was taken as comprising the 11 counties of Pennsylvania, New Jersey, and Delaware that are grouped about the Philadelphia-Camden metropolitan center and that roughly form a circle having a radius of about 40 miles, with a total area of 4,555 square miles. In Pennsylvania this includes the counties of Bucks, Montgomery, Chester, Delaware, and Philadelphia; in New Jersey those of Mercer, Burlington, Camden, Gloucester, and Salem; and in Delaware, the County of New Castle.

PRELIMINARY MAPS AND STUDIES

For field sheets a set of photostat copies of the topographic maps of the U.S. Geological Survey were enlarged to show the area included in the district to the scale of 2,000 ft. to the inch. Field surveys were made throughout the region in 1926 and 1927, and the existing conditions as to land use were indicated on these sheets.

On the base map, drawn to the scale of one mile to the inch, the information shown on the field sheets was plotted to form a preliminary use-of-land map. This map, the basis of the contemplated regional planning studies, showed in addition to state, county, and township names and boundaries, all waterways, highways, and railways, together with 100-ft. contour lines. Incorporated and unincorporated communities were differentiated, and a distinction was made between built-up lands and undeveloped subdivisions. Tracts of wooded land, exclusive of existing parks, were indicated in green. The locations of the larger estates were shown by spot symbols, as were those of the various golf courses throughout the region.

As the first step in the actual regional planning for the Tri-State District, the various aspects of the comprehensive plan were worked out in a broad way on a series

of diagrammatic maps. These were developed on reproductions, to a reduced scale, of the Federation's original base map. On this base, showing only the boundary lines and names of the various political subdivisions, individual theoretical plans for highways, railroads, parks, airways, and airports were developed. These preliminary studies later served as the basis for larger scale studies made on mile-to-the-inch copies of the large scale map later obtained by the Federation.

While the U.S. Geological Survey maps proved of great value in connection with the preliminary regional planning studies, the scale at which they had been issued (about one mile to the inch) proved too small to permit their effective use in studying the physical problems of the region and in mapping the projects on the Regional Plan. These topographic sheets, moreover, were for the most part based on surveys made more than 30 years before, so that a number of them were found to be seriously out of date.

Early in 1927 an arrangement was entered into between the Federation and the Survey, under which the Survey undertook to enlarge and correct the set of 24 topographic sheets showing the Tri-State District. The original topographic sheets were enlarged about two and one-half times, so that their scale became 2,000 ft. to the inch. In order that the revised set of topographic maps might be available to the public, an edition of 5,000 copies was printed.

In assembling the 24 sheets so that they could be viewed as one large map, copies were mounted on heavy cloth and trimmed so that they could be tacked to a special wallboard backing to form a composite map about 18 ft. long and 11 ft. high. They were so tacked as to be easily removable for drafting-room work on the map sections.

An aerial photographic map of the region was made in 1928. The area covered by the survey was about 3,850 square miles, and about 1,600 photographs were used in the map, although the actual number of photographs taken materially exceeded this amount. The original photographs from which the mosaic maps were constructed were so taken as to show the ground on a scale of about 1,600 ft. to the inch. This necessitated a flying height of 13,000 ft.

The aerial photographic map was made to a scale of 1,000 ft. to the inch, double that of the topographic base map prepared for the Regional Plan. Since the individual airplane photographs were assembled into 170 mosaic maps, enlarged photographic prints had to be made from the original negatives to the desired scale, 1,000 ft. to the inch. These enlargements gave opportunity to make certain adjustments in scale necessitated by variations in the flying height and position of the plane. After each mosaic was assembled, it was lettered by the Federation's draftsmen with white ink so that such features as streams, municipalities, highways, railroads, and canals could be readily identified. Each mosaic was then carefully photographed on large plates 16 by 20 in., from which individual atlas sheets were made, as required, by photographic enlargement to make the 25 by 31-in. sheets previously mentioned.

The 170 atlas sheets that make up the photographic map of the region would constitute, were they assembled, a map more than 35 ft. wide and 22 ft. high. The preparation of such a photographic map of the region, but at a scale approximating that of the topographic base maps, was effected by re-

THE PHILADELPHIA TRI-STATE DISTRICT

Fig. 1. (Left) An Area of 4,555 Square Miles in Three States

Fig. 2. (Above) Its Relation to Other Planned Areas in the Eastern United States

FIG. 3. ELEVEN COUNTIES AND FOUR HUNDRED GOVERNMENTAL UNITS HAVE JOINED IN PHILADELPHIA'S REGIONAL PLAN

producing the individual atlas sheets to a scale of about 2,500 ft. to the inch and then mounting them on a wallboard backing so as to form a picture map about 9 ft. high and 13 ft. wide. This was erected close to the assembled topographic base map, thus making convenient direct comparison of the two.

The use of these aerial maps greatly expedited the planning activities of the Federation by making it possible to locate many extensive projects in a preliminary fashion, suited to regional planning studies, without the necessity for physical surveys in the field. On these photographic maps it was possible to determine readily the practicability of any proposed location for, say, a highway, because every obstacle of serious consequence was shown. Where greater knowledge of details was necessary in the determination of the best routes for certain trunk-highway lines, the field studies made by the state highway departments met the requirement.

AERIAL PHOTOGRAPHIC MOSAIC, 10 BY 14 FT.
Representing a Year's Work and an Expenditure of $60,000

SCOPE OF THE PLAN

In January 1929, the Executive Committee decided after conference with its consultants and the Federation's staff, that the scope of the activities of the Federation should consist of basic investigations to formulate and present a comprehensive plan, focusing attention on the problems arising from the following major regional planning needs for a 50-year period: a study of probable distribution of population; a system of major and secondary highways, boulevards, parkways, and bridges; a system of parks, other public reservations, and connecting parkways; railway passenger and freight transportation facilities; waterways and ports; sanitation, drainage, and water supply facilities; and a system of airways and landing fields.

On June 6, 1929, the Federation undertook a comprehensive origin-and-destination traffic survey of all the modes of transportation of regional importance in the Tri-State District. In this survey the Federation had the cooperation of the railroads of the region, the bus companies, the interurban and urban electric lines, the ferry lines, the Delaware River Bridge authorities, the Fairmount Park Commission, and of the highway and traffic police departments of the three states concerned. About one million questionnaire cards were distributed to the traveling public, about half of which were handed to persons using the highways.

In the fall of 1929 the Technical Advisory Committee, which originally consisted of about 30 members, was enlarged to include the chief engineering officials of the region. The Executive Committee felt that no plan could be formulated that would adequately meet the needs of the region unless prepared jointly by the chief engineering officials, consulting engineers, architects, and landscape architects of the region in cooperation with the Federation's staff and the planning consultants. The intimate knowledge of the territory possessed by each one of this group was necessary in order to formulate a comprehensive regional plan to meet the needs of the people of the region as a whole. The Technical Advisory Committee comprises 200 members, of which about 150 are chief engineering officials.

BASE MAP PROCEDURE

As the first step in the final development of a regional plan on the base map, several special study maps were prepared. These were worked out on copies of the base map, showing existing conditions throughout the region. These copies were reduced by photography to a much smaller scale (one inch to the mile), which produced maps of more convenient size, yet sufficiently large for such preliminary studies. One copy of the base map showed a tentative highway and airport system, one a tentative parks and parkway system, and one set forth in some detail the water-supply developments, both existing and proposed, for various parts of the Tri-State area. Another of these copies was employed later to record graphically certain data relative to the Federation's origin-and-destination survey of passenger traffic in the region.

On the large base map, the various proposals for highways, parks, parkways, and other features of the plan were coordinated, the various proposals being indicated in colored crayon. Broken lines or hatched tints were employed to differentiate between the proposals and existing conditions previously indicated in solid lines or tints.

During the course of the study the map was constantly being revised, both with respect to the original and the new proposals added from time to time. This made it necessary to protect the designations of existing conditions from the changes and additions necessarily made to indicate the planning proposals. This was accomplished by applying a dull-finish, semi-waterproof, transparent fixative, on which the proposed plans were marked with crayon pencils.

In the large library and exhibit room of the Federation, also utilized for group meetings, a large wall map of the region was erected, equal in size and similar in general appearance to the base map already described. This exhibit map showed, by means of colored flags, map pins, and other devices, the location of all planning suggestions made from time to time by interested individuals and

organizations. Park and parkway suggestions were shown by green flags, highway suggestions by red, and others in similar fashion. Moreover, the colored celluloid flag designating each planning proposal was given a serial number that identified the suggestion. Arranged according to these serial numbers in a set of loose-leaf binders were individual sheets, each carrying blank spaces for a complete record of a given suggestion—its nature, location, and source, and file references to correspondence and maps, as well as its final disposition with respect to the Regional Plan.

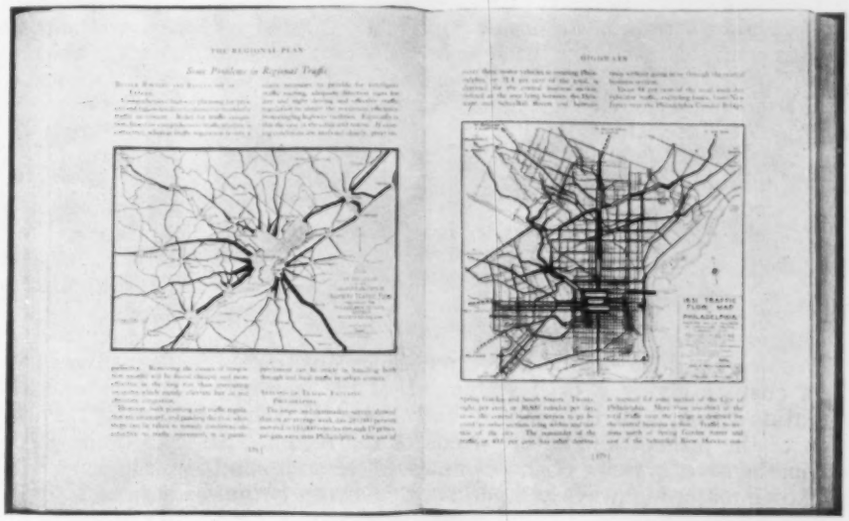
More than 350 proposals have followed this routine. Of these more than 40 per cent appeared on the preliminary plan map issued. Of the many others received subsequently, a goodly proportion have been incorporated in the Regional Plan. These suggestions frequently involved more or less detailed changes in the designation of important regional proposals.

First a tentative preliminary plan was prepared by the technical staff of the Federation in collaboration with the three planning consultants. Copies of this plan were sent to each member of the Technical Advisory Committee for its consideration, early in 1930. The plan was at a scale of two miles to the inch and showed the topography of the region, the existing conditions, and preliminary suggestions for regional systems of highways, parks, parkways, and recreational areas. The parks and parkways follow the many attractive creek valleys, for which the Philadelphia Tri-State District is noted, and which are ideally located to constitute a very great percentage of the park and parkway system. This preliminary plan contained over 200 proposals, 73 of which comprised suggestions that were made by interested citizens over a period of years and were indicated on the public relations map. Of the suggestions shown on the map, 67 comprised parts of proposals on the preliminary plan.

A series of group meetings of the Technical Advisory Committee was held at the Federation's offices during the early part of 1930 to discuss the proposed Tentative Preliminary Plan and the policies of the Federation in the carrying on of further planning studies. About 175 individuals of this committee submitted planning suggestions. These were classified by subjects and sent to each one of the 200 technicians studying the plan so that they might be informed of the views of the other members of their committee and thus be in a better position to discuss the planning suggestions at a series of meetings of small groups of the committee.

These meetings were held by subjects, such as highways and parkways, parks, parkways and public reservations; port and rail facilities; and aviation. Three or four meetings a week were held over a period of several months, at the Federation's offices. General meetings of the respective committees embracing the subjects enumerated under the seven phases of the plan were then held to further discuss the suggestions and findings of the group meetings. The reports from these general meetings were then submitted to the Comprehensive Plans Committee, which comprised the chairmen of all subcommittees and some other members of the Technical Advisory Committee, to make further studies of the suggestions and findings to ensure the complete coordination of all proposals in the Comprehensive Plan. Several general meetings were finally held of the entire Technical Advisory Committee until an agreement was reached on the Regional Plan.

There were 400 meetings and conferences, including the Technical Advisory Committee meetings, to discuss various planning suggestions, out of which the Technical Advisory Committee evolved the recorded conclusions reflecting the best collective ideas adjusted to the local and over-all needs of the region. This procedure, involving the collaboration of the public authorities, interested citizens, and technicians, ensured incorporation in the plan of a united and harmonious planning judgment as to the joint needs of the 400 political subdivisions of the region. It was a guarantee that the Regional Plan would be logical, practical, and workable and would meet the social and economic needs of the Philadelphia Tri-State District. The Regional Plan was finally approved by the Technical Advisory Committee on May 26, 1931. Early in June 1931, it was reproduced by county units in color by the lithographic process.



THE REGIONAL PLAN AS PUBLISHED—A 600-PAGE VOLUME

The Regional Plan Report contains about 600 pages, 10 by 12 in., one third of which are devoted to illustrations. It also contains a description of, and reasons for, the proposals made. The first section of the report is written in a non-technical language so that it will be easily understood. The second section comprises the supporting technical data, basic studies, and descriptions of the proposals included in the plan.

In the preparation of the various chapters, preliminary reports were submitted to the subcommittees of the Technical Advisory Committee for their consideration. The members of these subcommittees, which were composed of representatives of the public and private interests concerned, sent their suggestions to the Federation. Meetings of these committees were held to discuss the suggestions until the proposed chapters were finally agreed upon. The manuscripts were then submitted to the Executive Committee for approval. All changes suggested by it which were contrary to the principles agreed upon by the subcommittees were sent back to the subcommittees for their concurrence. The report, therefore, like the plan, contains the united and harmonious judgment of the public and private interests concerned.

The following résumé indicates the contents of the chapters of the final report. In the first or regional planning chapter is given a digest of the policies, prin-

ciples, procedure, and findings of the Regional Planning Federation. This chapter on the development of the region discusses the economic and social forces that have been at work during the 300 years since the Dutch and Swedes came up the Delaware. These forces, stimulated by the energies of the people in utilizing their geographical and topographical advantages, have made the Philadelphia Tri-State District one of the country's most important industrial regions.

Population studies, summarized in the chapter on population, were made by the staff in collaboration with the Population Committee, the consultants, the census authorities, and the Bell Telephone Company. Federal census data for 1930 show the population of the region to be more than 3,500,000. If present trends continue, it will total about 6,500,000 by 1980 and eventually will more than double.

The chapter on transportation and passenger transportation in the Philadelphia Tri-State District contains a brief picture of the transportation situation throughout the United States and of passenger transportation in the district.

Problems of highways and river crossings are treated in a chapter giving a brief statement of the highway situation throughout the country and a general discussion of the present and future needs of the region. A comprehensive system of 2,500 miles of existing and proposed major highways and parkways has been formulated as the backbone of the future highway system of the region. About 1,700 miles are on existing rights-of-way and 800 are on rights-of-way to be acquired. Twelve river crossings are proposed, seven over the Delaware and five over the Schuylkill. These may be either bridges or tunnels, depending on their economic justification and the regulations of the U.S. War Department.

In the chapter on port and rail facilities is given a statement of existing conditions and suggestions as to future requirements. The chapter on aviation was the work of a committee of leading authorities of the region on this subject. In it are discussed present and proposed airways and landing fields in the Tri-State Region.

Parks and parkways are treated in another chapter. The Regional Plan contains a comprehensive system, generally following the stream valleys. Park proposals include forest parks in Pennsylvania and New Jersey. The total acreage in the proposed system is about 130,000 acres, approximating a standard of about 20 acres per 1,000 persons by 1980.

Another chapter, devoted to water supply and sanitation, contains suggestions for meeting the future requirements of the region. In the chapter on housing, existing conditions are described and the needs of the future are pointed out. Finally, a chapter is devoted to the present and future architectural and esthetic phases of regional planning.

The appendix chapters, which contain basic data and descriptions of the proposals contained in the plan, are entitled as follows: Physical Characteristics of the Region, Population Studies, Use of Land, Subdivision of Urban Land, Origin and Destination Traffic Survey, Highway Technical Data, Port and Rail Basic Data, Existing Open Space Acreage, Recreational Facilities of Pennsylvania Forests, Summary of New Jersey State Park Proposals, Local Park Systems, Park Design, Effect of Parks on Land Values, Water Supply and Sanitation Basic Data, and Regional Planning Proposals.

The members of the Technical Advisory Committee and the subcommittees sponsoring the respective chapters of the report have devoted a great deal of time to the preparation of the plan and the report. Experience has shown that without the collective judgment of this group no plan or report could have been prepared that would have suggested an adequate solution of the present and future needs of the region. The people of the region owe a debt of gratitude to the members of this committee, to the interested citizens who also devoted a great deal of time to the work, and to the officers and members of the Board of Directors, who guided this most important undertaking. The members of the Federation's staff and the consultants are entitled to great praise for their very important contribution.

The Regional Plan in New Jersey

By HENRY J. SHERMAN
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, CAMDEN, N.J.

ON the back of the Official Road Map of the State of New Jersey for 1931 is a statement by Harold G. Hoffman, Commissioner of Motor Vehicles, in which he says that New Jersey is forty-fifth in area among the states of the Union; ninth in population, fourth in industry; and second to none in its great system of state highways.

Since the work of the New York Regional Planning Federation covers New Jersey south to the vicinity of Trenton and the activities of the Regional Planning Federation of the Philadelphia Tri-State District extend north to the same point—the two thus covering a large part of the state—there remain only a few counties on the eastern side where no regional planning has been done. Supplementing this work is that of the county and city planning commissions, the park and zoning commissions, and other agencies interested in the various phases of planning. There is only one county between New York and Philadelphia where county planning has not been undertaken. It is believed, therefore, that it may safely be said that New Jersey is probably second to no state in planning.

The population of the area covered in New Jersey by the Tri-State Plan is about 640,000, or roughly one sixth of the total in the Tri-State Region, and the area is about 2,000 square miles, or about 44 per cent of the total. Since this territory is largely undespoiled, the problem is one of conservation. In that respect we are fortunate indeed, for generally speaking park planning largely involves conservation.

In a large part of the District the population is about 150 to the square mile as against 88,000 or more on the Philadelphia side of the river adjoining Camden. Considering the accessibility of much of the state's undeveloped territory, its suitability for homes of low cost, and the ease with which present communication facilities could be expanded, it is inevitable that the population in concentrated parts of Pennsylvania should seek homes in

New Jersey. By following the Tri-State Plan, we are preparing to provide for this population in an orderly manner when it comes to us.

Extending along the Delaware River on both sides of Camden there is a large industrial area in New Jersey that has both a marginal railroad and a marginal highway. With its low land costs and its accessibility to the Delaware River, this area is sure to come into its own

CAMDEN'S WATER FRONT ON THE DELAWARE RIVER

and contribute its quota to the large and growing tonnage of this great water carrier.

Under an Act of the legislature of 1926, the South Jersey Port Commission was constituted and charged with the development of the Delaware River water front and its tributaries from Trenton to Cape May. This commission has constructed terminal facilities in south Camden and set up an organization which has achieved most gratifying results and augers well for the future of industry in south Jersey. Daily sailings are maintained to Baltimore, Md., and Wilmington, Del., and regular direct sailings to Pacific ports by two lines. In 1930 the commission inaugurated a service of direct shipments by motor vessels to the Great Lakes over the New York Barge Canal.

Trenton is just finishing a rail marine terminal of suitable proportions in connection with the completion of the 20-ft. channel to the city. Howell's Cove, Gloucester, has been chosen for a future marine rail terminal of large dimensions comparable with the proposed Hog Island development.

The New Jersey territory is especially favored in the number of tributaries of the Delaware River. These are suitable for such industries as need a cheap water front and yet do not require a location on the river proper.

Large level areas that can be easily and cheaply acquired, coupled with an excellent highway system, make much of the state's terrain particularly suitable for airways and airports. When normal business is resumed, it seems highly probable that these advantages will not

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TRENTON, N.J., NORTHERN METROPOLIS OF TRI-STATE AREA

be overlooked in the selection of future sites in this rapidly developing region. Locations for seaplane landing facilities, necessarily limited, are not lacking on the New Jersey side of the Delaware, and it is safe to say that if the merits of a particular site and the best service to the region were the only factors to be considered, a seaplane base would be located in New Jersey.

In connection with parks and parkways, excellent work is being done by the Camden County Park Commission, which has already developed a section of the Cooper River in Haddonfield, and another area near the headwaters of Great Egg Harbor in Berlin. Under the authorization given by the people of Camden County last spring, $3,000,000 are available for the further development of this park system. Among other projects, it is planned to develop Cooper River from Camden to Haddonfield to connect with the Berlin development.

TYPICAL WOODED AREA IN NEW JERSEY

Atlantic County is about to undertake a park development on the Great Egg Harbor River at Mays Landing, which will gradually be extended along this beautiful stream, with the idea that ultimately there will be a continuous parkway from Camden to the seashore. There is also a splendid opportunity for a parkway along the Rancocas and Mullica rivers. Such a project would require only a short connection between the two rivers to make a very fine parkway across the upper side of the region.

A unique feature of the area included in this plan is a large forest tract comprising about 100,000 acres in a single ownership. The middle of the tract is only about twenty miles from Philadelphia's City Hall—a very

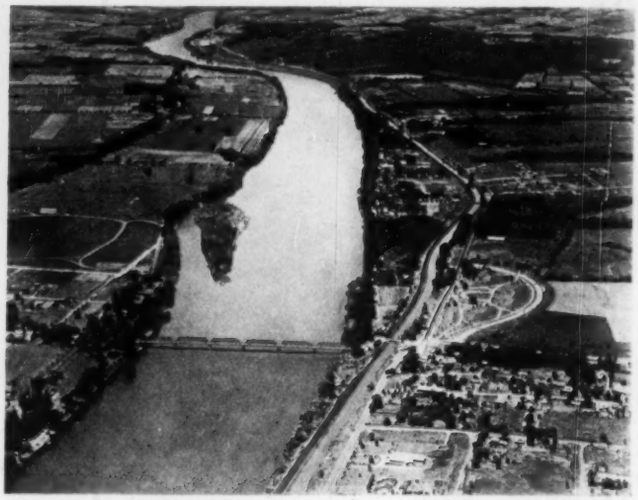
© *Camden County Park Commission*

COOPER RIVER PARKWAY AT HADDONFIELD, N.J.

short trip. There are four major possibilities for the use of this extensive and scenic forest area: forest preservation, water conservation, recreation, and conservation of wild life.

In preparation of the Tri-State Plan, grateful acknowledgment should be given of the support and hearty cooperation of the following agencies: the New Jersey Department of Conservation and Development, the New Jersey Highway Commission, the South Jersey Port Commission, the Camden County Sewer Survey Commission, the Mercer County Planning Commission, and the Camden County Park Commission.

New Jersey has everything to gain from the preparation of this plan, which has been presented to the citizens of the state without the expenditure of a dollar of public funds. It should serve as a foundation for orderly development and an inspiration to those in authority to set about its gradual accomplishment, giving special attention to those steps necessary to prevent spoliation or perverted use, the remedy for either of which would require heavy outlays.



WHERE WASHINGTON CROSSED THE DELAWARE RIVER IN 1776

Planning the Region in Delaware

By ALBAN P. SHAW

COUNTY ENGINEER, NEW CASTLE COUNTY, WILMINGTON, DEL.

TO the engineer of a county in which suburban development has taken place without any supervision or control, regional planning seems too good to be true. Close to the City of Wilmington, in New Castle County, Del., many suburban towns have been permitted to grow and expand in whatever manner the property owners wished. Administrative officials could only look on and wonder what the outcome would be, for they had no power to control the situation.

Several years ago a few prominent citizens, realizing where this hit-or-miss plan was leading, applied to the governor to approve a committee to investigate the advisability of creating a regional planning commission for New Castle County. In 1929, Governor Buck of Delaware appointed a committee of five men to investigate the advisability of establishing such a commission for Wilmington and vicinity. They were empowered to make their investigations and submit their findings together with their recommendations to the next session of the General Assembly. Acting on the recommendation of the committee, the General Assembly in 1931 passed an act creating a permanent commission, to be known as the Regional Planning Commission of New Castle County, to establish regional planning for Wilmington and vicinity. The act was immediately signed by the Governor.

This act specified that the commission should be composed of seven members: the Chief Engineer of the Street and Sewer Department of Wilmington, the Engineer of New Castle County, a representative of the State Highway Department, two members appointed by the Levy Court of New Castle County, and two appointed by the Mayor of Wilmington, all members to serve without compensation.

The purpose of this commission is to promote health, safety, prosperity, and the general welfare as well as to secure coordination of the plans for roads, streets, highways, parks, parkways, water supplies, sewers, sewage disposal, drainage, and other improvements outside the corporate limits of any city or town, and to prevent the unnecessary duplication of such improvements.

The commission met for the first time on July 6, 1931, elected a chairman and a secretary, and set the third Wednesday of each month as the time for its regular meetings. The Levy Court graciously appropriated $10,000 a year in its budget to carry on this good work.

The first duty of the Regional Planning Commission, the preparation of a series of maps showing existing conditions, is being performed. This "existing-conditions map" must be filed in the office of the Recorder of Deeds in Wilmington before July 1933. All the existing maps and data available that would assist the commission in its work have been collected. These maps were furnished by the Pennsylvania, the Baltimore and Ohio, and the Reading railroads; by Price and Price from private surveys; by the State Highway Department, the New Castle County Highway Department, the U.S. Engineers Office, and the City of Wilmington; and by

the Tri-State Regional Planning Commission. The section of the county north of the Town of New Castle had already been mapped by aerial photography for the Philadelphia Tri-State District, so that it was only necessary for the New Castle County Regional Planning Commission to do that part south of the Town of New Castle.

STATE BOUNDARY REDISCOVERED

The boundary line between Delaware and Maryland is marked by large stones set about one mile apart. The location of many of these monuments was unknown, but after many days they were all found. Much to our surprise they were marked by the letter *M* on the far side and by the letter *P* on our side, showing that Delaware had been a part of Pennsylvania at one time.

To make these stones show up in the aerial photographs, they were marked either by spreading large pieces of cheesecloth in the shape of a cross over them or by covering the ground around them with lime. When the photographs were developed, the locations could be readily picked out. It was then very simple to connect these points with a line, thus definitely establishing the state boundary. This one feature of the survey made the map very valuable, for it settled many questions as to whether a road or a building was in Delaware or Maryland. Some roads were found to be in Delaware that we did not suppose the county owned, and even now we hate to claim them. In addition, these maps have been very useful to the County Board of Assessment. They are also available for public use.

By means of many control points, or known distances between cross roads, a very accurate map was produced. One large composite map was made to a scale of 2,000 ft. to the inch and sectional maps were reproduced to a scale of 800 ft. to the inch.

THE HISTORIC BRANDYWINE IN DELAWARE
A Potential Parkway on the Regional Highway Net

NOTABLE PROGRESS BEING MADE

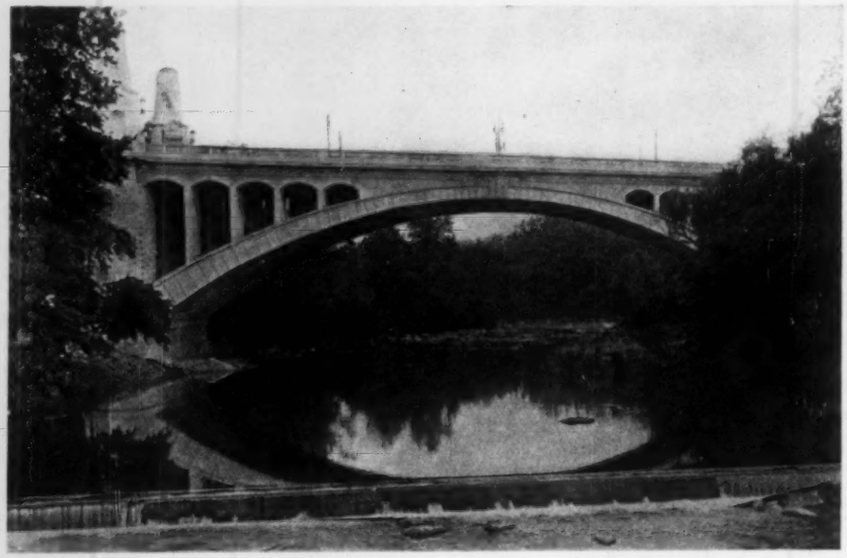
So far, the Planning Commission has finished a wall map on the 2,000-ft. scale, complete in three sections: northern, central, and southern. The existing conditions map is about three-quarters complete. The rules and regulations, in the form of "A Guide to Subdividers," have been completed in a tentative form. The base maps for the master plan are being made so that they cover 5 min. of longitude and $2\frac{1}{2}$ min. of latitude. There will be 57 of these block plans. To date (October 1932) the base map is about 30 per cent complete. As this map must be recorded, many trips have been made to neighboring planning commissions to find out how they recorded their plans.

PORT DEVELOPMENT AT WILMINGTON, DEL.
This Marine Terminal Is a Municipal Project

SUBDIVISIONS AND SANITARY CONDITIONS CONTROLLED

The wise committee that drew up the act creating the commission did not overlook one very important point, which is that the plan of a new development cannot be recorded until it has first been approved by the commission. To be sure that this regulation is complied with, they placed a few teeth in the law, making

any recorder subject to a fine if he accepts a plan without such approval. This gives the Planning Commission absolute control over new developments, so that drainage problems will be taken care of and all streets will have continuity.



WASHINGTON STREET BRIDGE OVER BRANDYWINE CREEK AT WILMINGTON, DEL.

Another law recently passed empowers the Levy Court to construct sewers and sewage disposal plants outside incorporated towns. This gives the county authorities direct control over the sanitary conditions of the county. In addition, the State Board of Health is willing to cooperate for the betterment of all communities and is ever striving to improve sanitary conditions. The Water Department of Wilmington, realizing its responsibility in connection with this regional plan, has recently completed the Edgar M. Hoopes Storage Reservoir, thus ensuring the water supply of Wilmington for many years to come.

ROADS, PARKS, AND BRIDGES

New Castle County abounds in beautiful streams, such as White Clay Creek, Red Clay Creek, Brandywine Creek, and the Delaware River on the east. These all provide wonderful opportunities for the establishment of parks and parkways along their banks, making possible plenty of recreation centers. The present narrow dirt road paralleling the Brandywine Creek from Rockland to Smith's Bridge should be developed into a parkway of unusual beauty to preserve the natural charm of this historic stream. Such a parkway could be extended from Wilmington far into Pennsylvania.

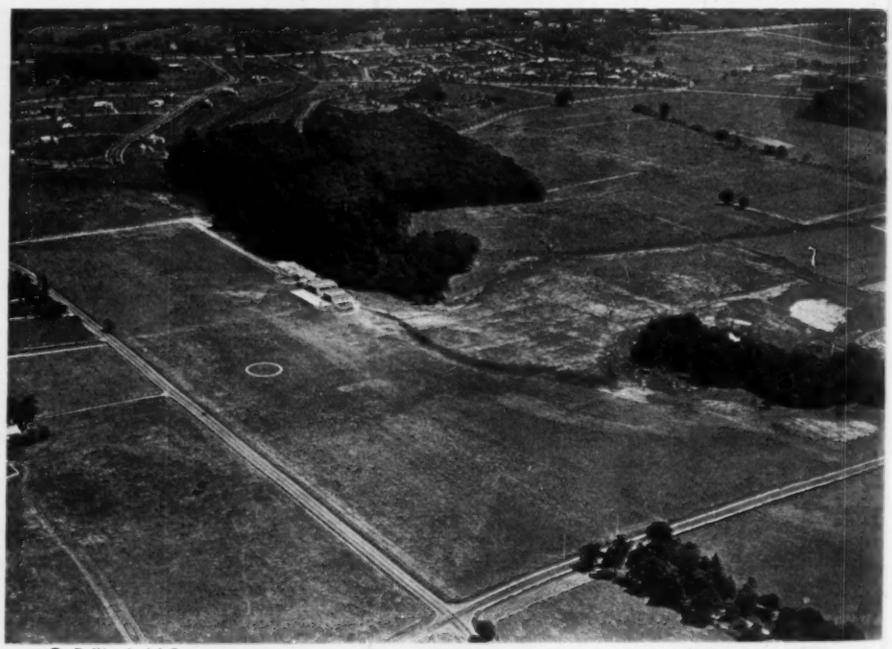
Delaware is known for its good roads, but although the main through highways are about completed, there is plenty of need for secondary roads. The State Highway Department is now preparing to handle the heavy through traffic between New York and Washington by constructing a dual highway.

While this work is under way the county is keeping abreast of the times by constructing heavier and wider bridges. At the present time it maintains over 500, which range from the old covered bridge to the new reinforced concrete arch. Some of the old covered structures, with their hand-hewn timbers, are works of art. Of special interest among the new bridges is the proposed structure over the Delaware River between Delaware and New Jersey. This is one project that our Regional Planning Commission hopes to see accomplished.

New Castle County is well supplied with airports, there being five at the present time, three private and two commercial.

On completion of its existing-conditions map the next step of the Planning Commission will be to prepare a master plan. For this, the suggestions of the Tri-State Regional Planning Commission will be studied, together with any ideas or suggestions the County Commission now has or may receive. Thus, by the coordinated efforts of all the various state departments, a well planned and healthful region will evolve in New Castle County.

The present Regional Planning Commission is composed of Charles Kurtz, Chairman; J. Simpson Dean; S. D. Townsend; Lammot du Pont, Jr.; E. R. Mack; Harry Maier, and the author. The commission is greatly indebted to Charles E. Grubb for his suggestions and help and to the Tri-State Regional Planning Commission and its representatives for their valuable aid and assistance.



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HENRY BELIN DU PONT AIRPORT, AT WILMINGTON, DEL.
One of the Finest Private Airports in the Country

Economics in the Depression

A Symposium on the Causes of, and Remedies for, the Falling Off in the Nation's Business

WITH the great decrease in construction work in the United States—a normal annual total of nine billion dollars reduced to but three billions in the present year—engineers are turning their attention to the underlying causes for this situation in an effort to stimulate public works construction and thus bolster up the decreasing total annual construction expenditure. The keynote of Mr. Hogan's article is that this country is still in the development stage and that construction must continue in order to improve the average well being of our citizens. Mr. Pirnie decries the orgy of tax reduction that has only resulted in a decreased national income and a greater demand for money to relieve destitution. For the future, he believes that the construction of public works should be the normal outlet for the nation's surplus productive power and that its productive energy should be thus converted into public wealth. Mr. McDonald's plan for economic stabilization involves combining compulsory corporate reserves with public works construction. These three papers, all of which were presented on October 7, 1932, before the Engineering-Economics and Finance Division at Atlantic City, provoked interesting discussion from the floor.

Capital Facilities and Construction

By JOHN P. HOGAN
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

AS a country we are still in the development stage, and construction work constitutes about 20 per cent of our normal business. We cannot therefore have what we consider normal prosperity without construction activity. Our normal annual building program is about nine billion dollars, or one tenth of our annual income, and the business created during the year by this initial expenditure is many times the nine billions actually dispensed for the work. During the year 1932 the indications are that we will spend less than three billions on construction.

If development is to be arrested in this country, we will return to the stabilized economy of Europe. There, people exist to a great degree by the sort of business that has been described as "taking in each other's washing," or on commissions on world trade and finance. Our prosperity, on the other hand, has been founded largely on the creation of new enterprise, based partly on our natural resources and partly on our creative and inventive ability. If it is necessary for us to face a stabilized economy, we must expect an extensive prolongation of unemployment during readjustment, and loss of our leadership. This is a policy of defeatism, which we should not accept until we have made a determined effort to retain our position and maintain our forward impetus.

Normally, public works constitute about one third of our building program; housing and commercial building, another third; and the increase of productive facilities, the remainder. Public works, housing, public utilities, and some commercial building represent, with few exceptions, the only permanent additions to our national wealth. Public works are the only construction activities that do not eventually require a purchaser and are therefore substantially the only opportunity presented to us of providing surplus purchasing power. No one would at this time advocate any increase in the construction of productive facilities when the majority of manufacturing plants are operating at from 20 to 60 per cent of capacity. Utility construction and commercial building are confined to urgent, immediate needs, aggregating between one billion and one and a half billion dollars for this year, or about 40 per cent of normal.

During the past decade, our normal public works program was about three billion dollars per annum, of which one tenth, or 250 millions, was expended on Federal projects. During the depression, the Federal program has been accelerated to a total of about 500 million dollars per annum. This year it would appear that state and municipal works, ordinarily comprising nine tenths of our public works program, will not aggregate more than 800 million dollars (of which the greater part is roads) compared to a program of nearly two and a half billions last year.

Regardless of whether or not our public works program was too ambitious, the suddenness of the deflation was unwarranted and caused increased unemployment, distress, and suffering. Deflation can go too far; as practiced during the past year it has consisted generally in deflating the "other fellow" without regard to ultimate consequences. Deflation of real estate by unemployment, and the consequent loss of rental, have caused the banks and insurance companies that hold the mortgages to attempt to deflate taxes. This action was effected initially through the investment bankers, who acted in a measure as agents of the banks and insurance companies.

No discrimination has been shown in this attempted deflation between the operating expenses of municipalities and their capital expenditures. As a matter of fact, municipalities, because of legal restrictions and political considerations, have found great difficulty in immediately deflating salaries and operating expenses and have therefore generally suspended their public works. This has caused increased unemployment and loss of purchasing power, further loss of rentals, greater deflation of real estate, and so on in a vicious circle. In all our attempts at deflation we have almost lost sight of the effect of increased unemployment in causing loss of purchasing power.

Approaching the subject of construction work from the industrial and financial point of view, we find that during the decade 1921–1930 there was an enormous increase in the productive capacity of industry notwithstanding the decrease, in the last few years, of real purchasing power. Mechanical and electrical improvements

have been blamed for increasing productiveness and generating unemployment. On all sides the theory that we should cast aside our efficiency methods and return to hand labor is advocated, together with similar "quack" ideas. In other words, we are urged to make a smaller amount of goods cost more, so as to spread employment. This is about as sensible as saying that because an automobile has got out of order or out of control we should go back to a horse and buggy.

It seems obvious to an engineer that we should spend our money as economically as possible and get as much as possible out of it. If we then find that to provide employment we must spend additional sums on work that is non-productive from the point of view of making profits, but only productive as regards the general welfare of the public, that money could better be provided out of the savings or profits of efficiently conducted production.

From a financial point of view, it appears that a mistake was made in borrowing so much money for increasing productive facilities and in capitalizing this expenditure to so great an extent in the form of long-term, fixed-interest-bearing obligations. The capitalization of productive facilities in the form of long-term bonds greatly increases the fixed charges, as compared to the labor cost of the goods. Furthermore, the general introduction of modernized methods has greatly reduced the margin between the high-cost and the low-cost producer.

In case of general loss of purchasing power and consequent drop in consumption, all manufacturers will continue to operate as long as they can earn even a part of their fixed charges, and they are actually obliged to attempt to earn a part of the carrying charges on their funded debt or go into bankruptcy. The result is that the decline in purchasing power and in consumption has not been accompanied by a comparable shutdown of operating plants, which in former depressions has been a means of eventually correcting overproduction. The capitalization of productive facilities or, indirectly, of purchasing power in the form of long-term bonds, has created a fictitious form of security and has sustained overproduction. It would appear that the bulk of these securities should have been short-term notes retired out of profits. It should be noted that many of our largest industries, including the U. S. Steel Corporation and the General Electric Company, followed the policy in prosperous times of retiring all their bonded indebtedness and getting as nearly as possible to a common stock basis.

So clearly are the present evils of over-capitalization recognized by advanced thinkers among financiers that many believe the only prime form of long-term investment in the future will be Federal bonds, issues for state and municipal public works, mortgages on real property, and very much reduced percentages of bonds on vital industries and utilities. If this belief is justified by time, interest rates on such obligations will go very low and public works will be greatly encouraged.

If so, the time will be hastened when the general public will become conscious of the fact that public works and certain public utilities represent in general the only permanent increase in national wealth. Roads, bridges, water works, and sewers of Rome, built over two thousand years ago, are still in use. Additions to productive facilities, on the other hand, remain wealth only so long as customers can be secured for the output.

It is important to recognize the fallacy underlying the theories of overproduction and to point out that there can be no such thing as overproduction in a basic sense. The human appetite is insatiable. As long as the greater part of the people in the world are living in misery, there can be no real overproduction until the average standard of living is appreciably raised. The semblance of overproduction is periodically created by decline in purchasing power, which may be due either to excesses—and by this I mean particularly financial excesses—or to maladjustments due to bad political, financial, or economic policy. The fundamental reason back of these excesses is that finance is normally conducted on the basis of immediate expediency, without sufficient regard to sound economic principles.

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NEW HIGH-LEVEL VIADUCT ACROSS THE NEW JERSEY MEADOWS
A Federal-Aid State Highway Project Crossing the Passaic and Hackensack Rivers

THE SELF-LIQUIDATING IDEA

One of the main errors in the recent futile effort to promote public works as a means of relieving unemployment, particularly as expressed in the so-called "self-liquidating" relief act, is the attempt to view the matter as an immediate financial problem, that is, with banker's eyes, instead of as a political, social, and economic problem of the greatest magnitude. The attempt to define a worthy public work as one that will be self-liquidating, in the same sense as is a private commercial project, has been relatively a failure on account of this narrow, financial viewpoint.

In the first place, those imposing their views in the making of this legislation apparently lost sight of the fact that our public works and utilities form the basis of all our private and commercial development. Many types of public works furnish the impulse for private developments of much greater value than the cost of the public works themselves. Bridges, if properly located, make new territory accessible for development and often lead to private building of many times the cost of the bridge. Our present industrial structure could not stand without our transportation system of railroads and roads, and our cities could not exist without streets, bridges, and utilities.

ROADS SUSTAIN THEMSELVES

In the past year, one of the greatest objections by real estate and financial interests has been made against the expansion of the road program. It is estimated that the total expenditures on improved roads in the past 15 years have been in excess of 20 billion dollars. In view of the fact that our combined state and municipal net debt at the present time is around 13 billion dollars, it is evident that a large part of the cost of roads has been paid out of regular income. The majority of these improved roads are now more than self-liquidating through the gasoline taxes alone, collected by various governmental agencies, and the surplus from these taxes is employed for general revenue purposes. It is apparent that to date these projects have been reasonably self-liquidating. Yet we are told that our road program has been too rapid, although not much over a third of the main roads of the country have been improved and less than 20 per cent have been provided with a hard surface.

When the road program is considered from the viewpoint of private business, it must be realized that only through this program have we been able to build up an automobile industry with a normal annual output of between three and four million cars, and other enormous industries that are supplying gasoline, materials, and services for automobile operation. Yet, according to the "self-liquidating" theory, if we wish to borrow money for a road or a bridge, we must go back to the "toll" idea, from which the people of this country have been struggling for a hundred years to escape.

The principal cry against continuation of normal public works construction comes from the taxpayers, of whom there are two general classes: those who have great difficulty in paying their taxes because of reduced income, and those who are desperately trying to avoid the deflation of former speculative inflation. With the former we are all in sympathy. Perhaps the distribution of taxation is wrong and the burden placed on real estate is too heavy. The fact remains that the aggregate of all taxation in this country is relatively less than that in almost any other civilized nation. The question has too many ramifications to be discussed even briefly here.

AN ENGINEERING CONCEPTION

Let us differentiate between the cost of government and the carrying charges on permanent investments in community facilities, which are our only permanent contribution to public wealth. The total useful value of our public works has been estimated at over 50 billion dollars. Against this, there are outstanding net obligations of states and political subdivisions aggregating about 13 billion dollars. Looking at this matter from the commercial point of view, the public property is subject to a mortgage of about 25 per cent of its value. The service charges on this mortgage are less than a billion dollars per annum. Our total annual expenditures for government—including Federal, state, county, and municipal—are in the neighborhood of 13 billion dollars. It would therefore appear that, in opposing construction, the taxpayer's associations have been cutting at a small limb of the tree rather than at the trunk, which is made up of the operating expenses.

All these things will be considered in their proper light when we come to the realization that, after all, the only permanent benefit that can accrue to us as a nation is not the building up of large fortunes, but improvement in the average living conditions of the people. It is to be hoped that the engineering profession, which is founded on the idea of controlling the forces of nature for the benefit of mankind, will free itself from prevailing mass psychology based on deflationary ideas and return to the principles on which it is based.

In this return to normalcy the civil engineer should lead the way. The average mechanical or electrical engineer is an employee or an employer; the average civil engineer is either a servant of the people in some governmental unit or a consultant in independent practice. He therefore has and should have the public welfare more at heart and should be able to point the way to those of his brethren who, through the persuasive influence of their employers, have lost their perspective and have become investment-minded.

Public Works Financing

By MALCOLM PIRNIE
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

THE construction industry of the United States has demonstrated that in one year it can convert over ten billion dollars of capital into structures and facilities for public and private use. Efficient spending of this gigantic sum has been at once an engineering truimph and an economic catastrophe. The recent financial panic and business depression have provided data from which to make analyses of cause and effect that should, in the future, lead to the employment of the construction industry as the main stabilizing force in our national business. This possibility is a challenge to engineers so to broaden the scope of their analytical studies as to make themselves a directing influence in revising the practices of financing the works they design and build. Thus sound principles can be established that will ensure the continued building up of the public and private wealth of our nation. Besides creating for the convenience of man, the engineer of the immediate future must aid in assuring him the opportunity to earn at all times not only the necessities of life but also some of the things that add to its pleasures.

During the past ten years, about 80 billions of dollars

have been expended in public and private construction. In round numbers, 30 billions were for the construction of public works for states and their political subdivisions; 47 billions were for private construction; and only 3 billions were for Federal public works, including ships and aircraft. From the tables of "Estimated Total Volume of Construction in the United States," presented by Arthur D. Gayer, lecturer in economics at Columbia University, before a hearing of the Senate Committee on Education and Labor on March 11, 1932, it appears that the volume of public and private construction in 1928 was 10,091 million dollars, but fell to 6,942 million in 1930 and to 4,800 million in 1931. The decline was greater in private construction, from 6,460 million dollars in 1928 to 3,310 million in 1930 and 1,800 million in 1931. In 1931, private construction was only 28 per cent of its volume in 1928, but public construction was held up to 83 per cent of its 1928 volume.

NEW JERSEY'S HIGH-LEVEL VIADUCT CROSSING THE PASSAIC RIVER
The Hackensack River Crossing Is an Exact Duplicate of This

The activity in state and municipal public works tended to stabilize the entire construction industry by holding its volume in 1931 to 48 per cent of that in 1928 in spite of the nearly complete paralysis of private construction. Contrary to general belief, however, public works as a whole, including Federal construction, were not advanced in 1930 to combat the depression. In that year the total volume was 4,042 million dollars, and in 1931 it fell to 3,575 million, in spite of a noble effort to increase Federal public works by raising the 410 million dollar expenditure in 1930 to 575 million in 1931. These data show clearly that the expansion of public works construction was not tried as a means of combating the depression.

AN ORGY OF TAX REDUCTION

Early in 1930 there seemed to be a general acceptance of the policy urged by the administration to speed construction on all projects, both public and private, as the best means of furnishing work for those thrown out of employment by the falling off in manufacturing. Municipal projects already planned and financed were allowed to go forward and Federal construction was increased as much as was possible by the relatively small organization that had it in charge. A few private concerns endeavored to construct planned extensions but most of them stopped all construction.

Then all owners of real property began to emerge from frenzied studies to reduce overhead with the realization that taxes constituted a substantial charge prior to the interest on first mortgage bonds, and that unless taxes could be materially reduced this interest would soon be in default. Out of this realization grew a nation-wide propaganda, painting in vivid colors the gross extravagance of state, county, and municipal governments and calling on them to reduce expenses. Without weighing consequences, officials were ordered to stop planning public improvements, although those already financed were allowed to proceed to completion. Thus, in the summer of 1931, when legislation was being formulated to lend Federal credit to build new piers under the sinking foundations of banks, insurance companies, and railroads, the leaders and representatives of these same interests were uniting to stop the construction of new, and the adequate maintenance of existing, public works.

During the summer of 1931 the consequences of such a policy were foreseen by many economists and engineers. Many unorganized attempts were made to call attention to the serious increase in unemployment and the depletion of buying power that would result. These arguments were met, on the one hand, with the accusation that our cities, counties, and states had been on a drunken orgy of spending, which had increased taxes beyond the ability of the citizens to pay, and, on the other, with the determination to reduce the size of governmental organizations and stop expenditures for public works. Unemployment among engineers resulting from their wholesale discharge from private enterprises was rapidly increased by the dismissal of the engineering forces engaged on public works throughout the country. In many cases, this was the first supposed economy effected by local governments. Plans in progress for needed public facilities were discarded—plans which cannot now be picked up and completed without starting again practically at the beginning. Construction in progress continued in most cases to completion in the fall and early winter of 1931, when contractors' equipment was hauled to the yards and some half million men employed directly on the work, and a million more indirectly employed, found themselves without jobs.

Needless to say, it did not reduce taxes to throw a million and a half men out of employment so that they could not pay rent or taxes, or buy food and clothing. Taxes had to be collected from those who could pay, not only to meet the unaltered fixed costs of government but also the unproductive costs of unemployment relief. Nothing could have been less intelligent at such a time than to attempt an impossible reduction in fixed charges at the expense of a substantial and immediate reduction in gross revenue. However, in a panic anything may happen, and so far the only tangible effect of the war on taxes has been a substantial reduction in the national income and an increased demand for money to relieve destitution.

GENESIS OF SELF-LIQUIDATING WORKS

So thoroughly had business men become convinced that public expenditures must cease in order to reduce taxes, that it was futile to argue economic principles with them. The laborer digging a sewer trench was to them a symbol of increased taxes instead of a purchaser of commodities they needed to sell in order to pay taxes past due. Upon realization of such misguided public opinion, efforts to forward general public works construction were abandoned and a concerted drive was made to recapture public approval for such construction as could be supported by charges collected from all the individuals benefited. Such works were termed "self-liquidating" public works, to distinguish them from public works entirely supported from the general tax fund.

When the various states were proposing to distribute state funds to their political subdivisions for unemployment relief, the New England Water Works Association, in September 1931, suggested in vain that these funds be used to pay interest for three years on funds eight times as large, to be borrowed by the communities and spent for needed improvements in their water works. About this time the bond market collapsed. Interest rates on new bonds of conservative municipalities were raised perpendicularly from between 3 and 4 per cent to 6 per cent at a discount. Community governments learned that no bidders would respond to advertised sales of bonds bearing 6 per cent interest, and those communities that were furnishing useful work for many of their otherwise unemployed were forced to stop in order to conserve all available funds. Thus public works construction had almost entirely ceased by the close of 1931.

COMPLETED ROADWAY PROVIDES FOR FIVE LANES OF TRAFFIC
A Three-Mile Structure Between Newark and Jersey City

In January 1932, the American Water Works Association called attention to the advisability of water works construction to a total of more than half a billion dollars and pointed out the benefits that would result from initiating this work immediately. The interest of the regular investment banking agencies was solicited to finance the plan, but in spite of the fact that its execution would not increase taxes, the needed support was denied on the ground that the banks had determined to lend no more money to municipalities for construction work and that, in spite of the financial soundness of the water works plan, the adopted policy would not be changed. This is clearly stated in the resolution adopted by the Board of Governors of the Investment Bankers Association of America at its mid-winter meeting on January 30, 1932, which read as follows:

Resolved: That the Board of Governors of the Investment Bankers Association of America is opposed to the extension of public improvements which would necessitate an increase in the bonded indebtedness of states and municipalities under present conditions, and that public officials be urged to adopt programs of strict economy, adjust expenditures to actual income, and restrict the incurrence of bonded indebtedness to the end that taxation may be reduced and credit maintained.

To secure Federal credit for "self-liquidating public works" was the only hope remaining for financing any municipal construction work in 1932. A special committee of the American Water Works Association communicated with many Government officials and furnished copies of the plan prior to January 13, 1932. But all such suggestions were thrust aside when the Reconstruction Finance Corporation Act was passed without providing Federal credit for states and their political subdivisions, on the theory that Federal backing would allow banks to resume their normal functions, including the financing of state and municipal needs.

On May 9, 1932, the Society, by action of its Executive Committee, officially entered the battle to revive "public works construction as the most effective immediate means of increasing purchasing power, stimulating trade recovery, and reviving employment." This made possible an alliance of public works construction, manufacturing, and engineers together with the housing industries and architects, representing a substantial proportion of the private construction interests. Sponsored by the Construction League of America, the National Committee for Trade Recovery was formed, which carried to Washington the sound economic principles that had welded together the directors of at least 20 per cent of the nation's normal business. Their efforts aided materially in the passage of the Emergency Relief and Construction Act of 1932 extending Federal credit to states and their political subdivisions for the construction of public works that conform to certain rather rigid specifications.

In the act was erected at the last moment a monument to the tax war, on which was inscribed "(other than by taxation)." These words, inserted in the definition of self-liquidating projects, have proved a barrier of sufficient rigidity to prevent the lending of Federal funds to municipalities, as few of them have been able to qualify. Credit through private banking sources, however, became available almost immediately after the passage of the act, and needed works in some communities have been privately financed.

There is no doubt but that this monument has nullified the real intent of the Emergency Relief and Construction Act and has caused it to be administered as a banking formula. If the money is to be used rapidly, as intended, to increase purchasing power, stimulate trade recovery, and revive employment, the act as passed must be amended at least to the extent of changing the inscription on the tax-war monument, to read "(other than by increasing the percentage of fixed charges to value of real estate.)" As matters now stand, Circular No. 3 of the Reconstruction Finance Corporation stipulates,

This provision of the act clearly imposes the requirement that in order to be eligible for a loan, the project must be one which will produce sufficient revenues to make it "self-supporting" and to return its construction cost within a reasonable period. Taxation is expressly excluded as a source of revenue for such purposes.

It is obvious that such an interpretation of the act excludes loans for public works involving fire protection and sewerage, which reduce insurance rates and increase the value of real estate in much greater proportion than the cost of such services. In these circumstances, the ruling demands the discard of standard forms of equitable rates for such services and subsidizes real estate at the expense of the general public. This may have been the result sought by those who insisted upon such rigid requirements, and it would not be objectionable if means could be devised to increase the average purchasing power of our people to allow them to pay these added costs. A reduction in rents comparable with reduction in insurance costs and unearned increment in value of the real property benefited would effect the necessary adjustment.

Why do we allow such controversial and difficult remodeling of accepted standard financial practices to stand in the way of the intended immediate release of one and a half billion dollars for the construction of needed

public facilities? If we could follow the intent of the act, we could increase the public wealth by one and a half billion dollars, and release this money for labor directly employed on the works and in the mining, manufacture, and transportation of the raw and finished materials. These dollars, used by the re-employed to satisfy their accumulated wants, would flow through the channels of trade and industry with unprecedented velocity developed from the release of the potential demand built up during three years of vanishing purchasing power. Here is the possibility of at least an eight-billion-dollar increase in the business of the nation during the next two years.

DISPOSING OF EXCESS PROFITS

It is self-evident that the possession of money or credit, well distributed throughout the nation, is essential to trade. The present protracted drought in purchasing power began long before the depression. It was caused by constantly diverting from the channels of trade what were termed excess profits, derived from charges for services and manufactured goods greater than those required to compensate adequately for the services rendered, and to create a fair return on the capital invested in productive facilities.

The pressure to find investment for excess profits was too great to find an outlet at home and some ten billion dollars were almost forced as loans abroad. While those foreign donations were being spent for construction, our export trade was stimulated, but when the facilities created abroad began to produce goods, we had to raise our tariff wall to prevent the complete destruction of our already enfeebled purchasing power by foreign production. Naturally, this exported money was wasted, as we could not furnish purchasing power for foreign production, not having sufficient within our borders to keep our own production facilities in operation.

Business can be revived by a conscientious application of the intended constructive measures already enacted by our national government through the cooperation of all local governments; but it cannot be stabilized for future prosperity unless the causes of former excessive fluctuations in business are removed. Our nation can produce many times what it really wants to consume by reducing the average working hours to 30 a week, less than 36 per cent of the daylight hours of the year.

A WISE USE OF SURPLUS

In the future, surplus accretions should be heavily taxed by state and Federal governments, except in cases where it can be demonstrated that the normal demand will justify the extension of productive facilities. The money collected by states from this source should be apportioned annually through a state planning board to the various political subdivisions, to be invested in public works that will comply with the approved long-time plans of municipal, county, and regional planning boards, as coordinated with state and Federal plans. The work done in any year should be limited to the money available, thus abolishing double payment for interest and amortization of bonds. This plan would not apply to self-liquidating public works, which would be financed in accordance with the accepted methods of utility financing.

Money derived from the Federal Government could be applied to effect the construction of needed public works in those states where revenues fall below the general requirements of the nation as a whole. A definite proportion of it could be applied to the purchase of newly mined gold to be put into a stabilization account in the treasury. The amount of gold purchased each year would be adjusted according to the increased credit requirements of the business of the nation, but would be kept out of the basic business gold supply until needed to effect, through extension of credit, a needed reinforcement of purchasing power at such time as there should be a dangerous recession in general business. As matters now stand, the production of gold is not profitable in prosperous times. However, its production can be stabilized to maintain a firm foundation for the credit necessary to keep pace with the sound progress in our national standard of living.

This method of stabilizing business would flatten out the swings above and below normal by converting surpluses into new buying power through the medium of investment in permanent public wealth. Through the public works thus created, all the people might be given a beneficial means of employing their leisure hours. Excess profits, instead of being wasted, would be invested in facilities that would be available to all who were willing to work 36 per cent of their daylight years to earn the right to the enjoyment of these facilities. It is true that "we cannot squander ourselves into prosperity," but we can invest the excess proceeds of our labor in useful and necessary public works, thus preventing the wasting of these proceeds on useless facilities for overproduction at home and abroad—which is what we did to "squander ourselves into" this depression. We shall thus conserve our excess earning power by investing it in the creation of public wealth to better the standards of living of all the people. Can we not, therefore, devise means to prevent the squandering of excess profits and surpluses on facilities resulting in overproduction? In so far as we succeed, we shall fulfill the broader duties of the engineer of the immediate future.

A National Public Works Credit Corporation

By FREDERICK H. McDONALD
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, ATLANTA, GA.

THE most obvious fact brought out by the present economic disturbance is the practical cessation of business activity, which has sunk below any reasonable conception of a fair level of maintenance and consumption. The most obvious need that has existed for over three years, and still exists, is that of employment, and of some increased range of business activity.

Private enterprise, however, now has an expanded capacity that almost overnight could produce quantities of goods at present costs, far in excess of consumption even on a highly inflated basis. It is hopeless, therefore, to look to present productive enterprise for the generation of employment and business activity with the existing lack of any compensating demand.

The higher reaches of business activity are those above the requirements of daily-living consumption and ordinary maintenance. The basic source of this more profitable activity is replacement and new construction. It is from the production of new materials, machinery, and equipment for use in new structures, and in the maintenance, renovation, and replacement of old structures, that we get increased employment and the dissemination of purchasing power that creates these higher ranges of activity. However, private enterprise can go into new construction only when sufficient consumer products can be sold to justify new plant, or even the extended operation of existing equipment. At present there is no such consumer demand.

PUBLIC WORKS THE SOLUTION

The only available construction not on a consumer basis is that of new public works, using materials and labor in structures that do not have to be justified by financial returns, but by usefulness to the community. Nor do purchases for these works depend on individual employment or satisfactory individual business status. The whole wealth of the community is taxed a proportionately moderate amount per capita, in order to secure large sums for public works to serve the entire community.

Since the World War, private industrial and commercial facilities have advanced to a point momentarily far in excess of current needs. In only a few instances, however, have community facilities advanced as rapidly, or proceeded even to the point of meeting normal requirements. This means that there remain vast unfilled community needs. Old facilities are inadequate and overloaded, and new ones are inescapably required in the immediate future.

Much has been said regarding the economic advantages of a planned program of public works, but this concept has been largely confined to national public works financed from the Federal treasury. While these could be made to loom up large, the best that could be expected from Federal financing of any reasonably justified needs would be little as compared to the enormous total arising from great numbers of individual communities. This means that in times of general business depression a great volume of new, business-creating construction could be released if such communities could obtain the necessary finances.

It is a paradox that in spite of these needs, and the legal ability of the communities to finance works to meet these needs, the municipal bond market has been so unsatisfactory as to make the necessary securities unsaleable. This has been an off-shoot of some defaults, of many unbalanced budgets, and of the fear of future defaults. All this has had a depressing effect on the market for municipal securities, which has been reflected in the widespread inability of local governments—states, counties, and municipalities, even those that are reasonably sound—to sell their securities within the statutory limitations, which specify that such obligations must pay a certain maximum rate of interest and must not be sold below par. This brings us to the inescapable conclusion that if, in time of economic depression, the normal low-interest market could be maintained, large volumes of construction work could be released. At such a time it would be most effective in correcting depressed business conditions.

WHAT TYPE OF AGENCY REQUIRED

To make such funds available, the Government has recently given enlarged powers to the Reconstruction Finance Corporation, as provided in the Emergency Relief and Construction Act of 1932. This act is the first planned attempt to provide a special market for local governmental securities for construction at a time when the general market has been unfavorable. The limitations involved, however, are such as to almost entirely vitiate the stated objective. In order to prevent tremendous and uncontrollable demands on the Federal treasury, it has been judged necessary to limit the funds to the purchase of certain types of "self-liquidating" projects. This terminology is an entirely new concept as a controlling factor in public-works financing. Hitherto public works costs have been conceived as being a tax on the general public to provide facilities for general public use; little if any attempt has been made to attach service charges that would return the operating and fixed annual costs, as well as retire the original loan.

It therefore becomes necessary to go through legislative processes as well as to educate the public in order to attach rate charges to many services that are at present not paid for directly by the users. Many public works, such as schools, paving, fire department buildings, hospitals, and administrative buildings, do not render a measurable individual benefit that would permit of a reasonable charge for use. This limits the application for most funds to such individual consumer services as are provided by water works, electric light and power plants, and possibly sewerage works. The bulk of the available construction, however, is in the field of general-use structures, and it is in this larger field that most progress can be made, if financing can be assured.

POSSIBLE METHODS OF FINANCING

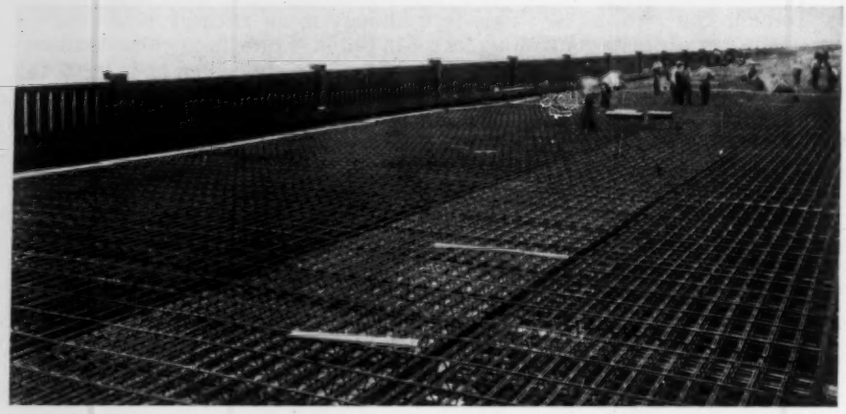
The thought has been advanced that the Government might tax individual and corporate incomes in the higher brackets to provide a central reservoir of funds for distribution either directly to local communities in proportion to their needs for public works construction, or in the purchase of their securities. This process would be highly undesirable as regards the origin of its funds and difficult in their distribution. I am convinced that the solution of this problem lies in the creation of something closely akin to a municipal bond investment trust. Undoubtedly if, through a central institution of this type, purchases of local governmental securities were made over a wide territory, and pooled as collateral against trust certificates, many advantages would result. The security for these certificates would be sound, selective, and diversified, and could be made tax exempt by a proper form of trustee arrangement. These conditions could be so set up as to relieve purchasers of the burden of careful diversification and selection in the open-market.

The problem of setting up a form of municipal bond investment trust that would provide a central reservoir whereby the investing public as well as corporate reserves could find an unquestionably sound, select security, having a tax exempt return and a reasonable rate of interest, is a study in financial procedure and belongs to another field than engineering. The writer has, however, worked out the elements of such an institution, in the form of a National Public Works Credit Corporation, which does not draw management and trustee fees by diminishing the income from the securities held in its portfolio, and seems to meet the requirements of our general problem. It has had the approval of recognized, sound authorities in this field, and incidentally provides ample scope of operation for engineering talent and for the construction industry.

In addition to its investment advantages, this agency

would set up a yardstick of credit risk applicable to the purchase of municipal securities that undoubtedly would gradually standardize the internal basis on which governmental securities should be issued, and tend to stabilize the financial condition of the local governments behind these securities. In time, the pressure of these standards should exert exceedingly wholesome influences on community budgets.

If a new, private business enterprise be not worked out, the question then seems to revolve around the development of either a source of money for investment in these trust shares that would be content with a relatively low rate of return, or the provision of some agency for handling an institution of this type that would not have to get all its carrying or operating charges directly from the low average income derived from the investment of these funds in municipal securities. This latter indicates, for one source, some governmental channel. I would suggest that such an agency could be set up either under the Federal Treasury Department or the Federal Reserve banking system.



REINFORCEMENT FOR ROADWAY SLAB OF NEW JERSEY'S HIGH-LEVEL VIADUCT

Additional assistance in securing such investment funds would result from making these primest of security certificates acceptable as collateral for the issuance of currency by national banks. In a way this would be similar to the recent provision of the Glass Amendment to the Home Loan Bank Bill to permit the use of Federal Government bonds, with certain qualifications, for this purpose. This provision would enable our securities to be liquidated or sold at par at any time when cash might be necessary, or when it might be indicated as desirable to purchase local governmental obligations, even in times such as the present, when the general municipal bond market might be found unfavorable.

CORPORATE AND BUSINESS RESERVES

Another way to provide these low-interest funds for investment in municipal bonds centers in the creation of corporate reserves for stabilizing business. These reserves would maintain employment and some approach to a normal dividend return to investors during bad business periods. Such reserves would have to be invested in securities that could be readily liquidated without serious loss in times of slack business or economic depression. These requirements would justify a very low rate of interest.

A plan for developing economic stability based on certain compulsory corporate reserves has been worked out by the writer. This proposal recognizes that depressions are results and not causes, and that the unwise use, during periods of prosperity, of surplus profit and the capitalization of estimated future earnings as a basis of expansion and dividend disbursement, have created bulges of excess business activity without sound or stable foundations. Instead of saving from this momentary, maximum income to ensure continuity and regularity in the future, it has been the habit of American business to glut from today's full larders the very sustenance of tomorrow's existence. This necessarily has created an absence of resources for subsequent lean periods, which we have called depressions. It is fairly obvious that if we can prevent or dampen excess activity in periods of prosperity, the subsequent reaction cannot sink to anything like the extent it has in the last few years.

OVERLOOKING OBVIOUS FACTS

The greatest error of business has been its failure to recognize an inevitable ebb and flow in human activity, and to balance its books over the resulting periods of cyclical rise and fall, instead of using only the short, seasonal variations now measured by annual statements. No business man considers daily or monthly surplus as net profits, available for free use or distribution. Nor does he concede that the book balances of these periods are any index of his operating stability. He takes pride in his knowledge of momentary and seasonal variations, and insists on at least twelve months as the measuring period for operating analyses. Yet experience should indicate that these cyclic fluctuations can be shown as fairly even balances within overlapping ten-year groupings. Annual balances bear the same relation to these periods as daily and monthly variations bear to yearly statements.

Why not take the decade book-balance as an accepted measure of sound operation? Why not introduce such measures of reserve building and operating control as will enable the striking of a balance at some level of basic regularity of production, employment, and dividends, over ten-year periods? This would be practicable stability. If we do not make this provision, we are wilfully ignoring an obvious and unavoidable fate.

WRONG USE OF PREMATURE PROFITS

A second great error of business has been its failure to recognize that the first extra earnings, from full or excess operations, are not likely to be permanent, and therefore should not be freely used for present dividends or forced-draft expansion. These earnings are, in fact, premature profits. Their immediate use as authentic or disbursable—or for any other purpose than the creation of a segregated reserve to fill in the inevitable subsequent leaner periods in the cycle—results in the dangerous undermining of future stability.

With the need for carefully examining the periodic or cyclical status of an enterprise, comes the necessity of analyzing current annual surplus. Are these extra earnings the product of excessive activity, over and above normal? If so, it would be necessary to determine whether they indicate the existence of one of those periodic bulges that almost inevitably warns of succeeding less active periods. Unless some adequate reserve already has been set up, it is desirable to store these profits in such a reserve as will be readily available. When this "Stabilization Reserve Fund" has been built

up sufficiently to ensure maintenance of the business structure, then, and then only, can excess profits be regarded with safety as authentic profits available for disbursement or other productive use, as for the expansion of the business.

THREE ELEMENTS INTERRELATED

There have been many proposals based on the conception of unemployment insurance as a panacea for economic instability. Due to the vagaries of individual enterprise, there is no actuarial basis for determining the frequency, numbers, or financial amounts involved in unemployment. Any form of purchasable insurance would seem beyond the limits of ordinary premiums. Most plans so far developed have been for a self-provided type of insurance of business stability, and have the complexion of limited employment-benefit funds. They comprise only some form of deduction from gross income or wages, with contributions by management, and apply only to some of the lower paid workers.

Actually, any stabilized business structure rests on a tripod of interlocked, supporting human elements: workmen (or labor), management, and investment. Each suffers if there is lack of employment and loss of income. Therefore, no plan of stabilizing one essential which does not provide for all three can be either sound or effective.

In addition, it is necessary to recognize that we must reach stability before we can maintain it. No business is stable until fair wages, salaries, and minimum interest on the investment have been provided from income. These elements, however, will be brought below the competitive market if a percentage of gross income is deducted from their normal levels to build reserves. Otherwise, this deduction adds to the selling price of the product, throwing it out of line, or adding to costs at a time when economy is the very key to business salvation. Only when reserves are built up from income in excess of normal costs can stability and the possibility of its maintenance be said to have been reached.

COMPULSORY RESERVE FUND

In detail, the author's reserve plan proposes to stabilize business by requiring corporations to withhold all earnings in excess of the legal rate of interest until a permanent, liquid stabilization reserve has been developed in the form of a segregated, tax-exempt trust fund equal to the minimum of one year's salaries, wages, and primary dividends. This is to be used only as an emergency fund to provide continuity of employment and some income to labor, management, and investors during lean years, by a rate of payment limited to a maximum of one-half year's normal income in any one year. This provides the equivalent of two years' income at half pay. It is not proposed that it be used as a dole to the idle, but that all qualified employees be kept on part time, in proportion to actual production needs.

Private, non-regulated corporations would have this requirement imposed by the state as the price of obtaining a charter to do business, but at any prior time they might voluntarily adopt the plan. Regulated public-service enterprises would have such an additional allowance made in their rate structure as would permit the accumulation from net earnings of an annual, designated percentage for the stabilization fund. Other excess earnings also would be paid to the fund. This provision alone, made effective now, would have a tremendously beneficial effect on railroad and utility securities. Applied to the railroads, for instance, it would do away with the iniquities of the present recapture possibility, and remove restrictions that prevent building up of unconcealed reserves during prosperous periods to ensure continued operation during subsequent lean periods.

TYPICAL RAMP CONNECTION TO SURFACE ROADS
For the Diagonal Bridge, New Jersey's New High-Level Viaduct

A second step of participating distribution of excess corporate profits, subsequent to the completion of the prescribed stabilization reserve, is left to voluntary arrangement between employees and owners. This will ensure a more widely distributed and a more dependably uniform purchasing power.

COMBINING RESERVES AND PUBLIC WORKS

After the stabilization of business operations has been considered, the question of the additional stabilization of consumption arises. The answer lies in the investment of these reserves in non-consumer commodities, or in the previously mentioned public works construction. This produces business when normal industrial activity is at an ebb.

In this dual, interrelated proposal of combining compulsory stabilization reserves with controlled public works construction we have a foundation on which a superstructure may be developed that will gradually grow to a more perfect type of progressive social institution. Our hope for the future lies in a recognition of the need for changes. Only actual progressive effort will achieve any change from the present, hazardous status that has so clouded our business horizon.

Finally, it is time for every business interest to awake to realities. We must judge how much more profitable it would be to build up a controllable, but modified, form of business structure than to risk revolt, or forceful appropriation by political interference. Wise men can capitalize the inevitable.

Primarily, engineering is the art of the proper fixation of permanent wealth. On this basis of new construction rests the stability, the growth, and the betterment of society. The engineer holds the key. He can use it for his own and the community's great good; he must not allow himself to be superseded by others who may appear to be more far-seeing, more energetic, but who usually are more self-interested. The engineer can fulfill his natural destiny in pointing the way, by planning the construction of a new road to economic progress.

The Railroads' Plight—Causes and Remedies

Economic Difficulties of Today Yield to Aggressive Study

By Elisha Lee

Vice-President, Pennsylvania Railroad Company, Philadelphia

MANY Americans are decidedly pessimistic regarding the future of our railroads. They view with alarm recent tendencies toward declining use and impaired earnings; to them this great national industry is about to be relegated to the discard. Not so Mr. Lee. From the vantage point of the vice-presidency of our largest railroad, he is in a position to see the problem from the inside. In this paper, delivered at the dinner on October 5, 1932, in connection with the Atlantic City Meeting, he frankly discusses the handicaps of the railroads, particularly with respect to uncontrolled motor-vehicle competition, and suggests practical remedies which he conceives to be of the greatest public benefit.

IN discussing the subject of transportation, I speak primarily of its economic and social problems rather than of its technical or engineering phases. The prices to which railroad securities descended during the early summer of 1932 indicated a state of public alarm for the future of these great properties, and the low levels then reached could only have been justified on the assumption that these carriers were about to go the way of the stage coach and the Conestoga wagon. No intelligent man, least of all one trained in engineering, could on calm consideration subscribe to such a view. The railroads have advantages of efficiency, low cost, and dependability of operation approached by no other transportation agency. They have been essential factors in the rapid growth and development of this country; they are equally essential to its continued life; and I do not think that there is the slightest likelihood that any one now living will see them supplanted.

The extreme and unwarranted apprehension as to the future of the railroads, which was felt in the recent panic days, and which to some extent still prevails, seems to have had two general causes. One is a more or less popular belief that the effects of the depression have been more destructive and dangerous to the railroads than to any other great industry. This, I believe, is an error. The railroads have been able to hold up their heads fairly well under the distress of these times, and this is a magnificent testimony to the indispensability of their service, to their conservative financing and, if I may be permitted to say so, to the character of their managements.

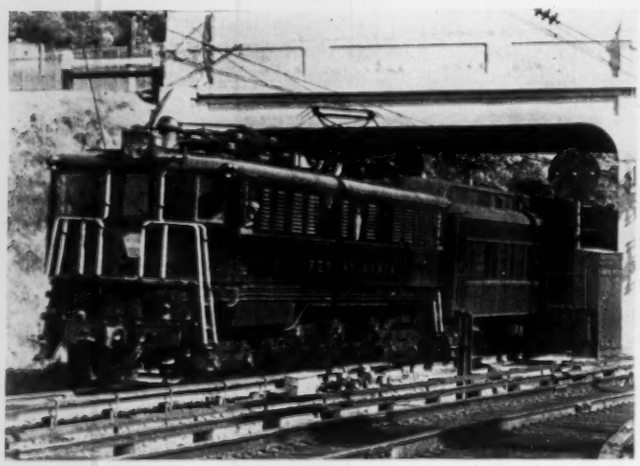
As the second cause for excessive pessimism regarding the railroads I mention the focusing of so much attention on the rapid growth of competition against them on the highways and waterways, particularly in the last few years. I do not mean to infer that this situation does not require attention. It does, and urgently; but an effort should be made to appraise it soberly and not under the influence of an almost hysterical fear. In the minds of many good people, this competition has taken on the appearance of an incurable disease, certain sooner or later to have a fatal termination. The truth is, that the disease is entirely curable, and the remedy not unduly difficult to find or apply.

An interesting fact is that the phenomenon of highway competition is by no means peculiar to the United States. It is almost as world-wide as the business depression itself, although in some cases other countries are ahead of us in their progress toward a solution of the problem of establishing equitable and fair relationships, in the public interest, between rail and highway transport.

In certain countries where the railroads are practically or completely under government ownership, measures of an exceedingly restrictive if not prohibitive character have been taken against highway carriers. These measures have been much more drastic than anything contemplated or suggested in the United States.

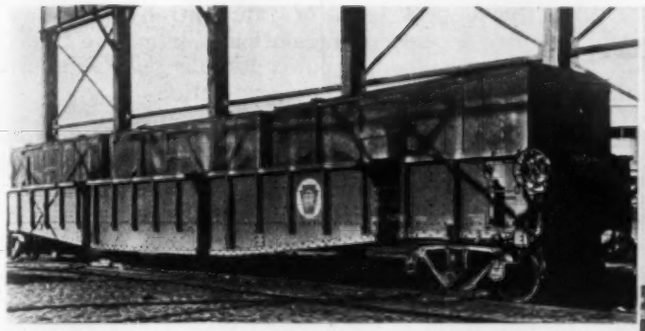
British Study Points the Way

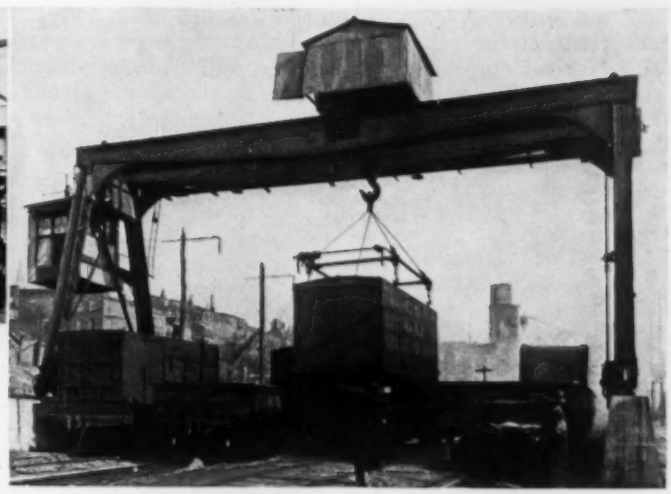
A British conference of experts, reporting to the Minister of Transport, and headed by the celebrated economist, Sir Arthur Salter, has just completed its recommendations for the solution of the problem in Great Britain. Perhaps the most important of its interesting and informative conclusions is that all the costs of highway construction and maintenance, averaging in recent



Locomotive for Use Between New York and Philadelphia
Line Between Two Cities to Be Electrified After February 1933

Hopper-Bottom Car for Transporting Cement in Bulk
A Water-Tight Container Having a Capacity of 50 Tons





CONTAINER CARS FOR LESS-THAN-CARLOAD FREIGHT
Containers Transported from Car to Final Destination by Truck

years the equivalent of $300,000,000 annually, should be borne entirely by those using the highways, and that trucks should pay their fair share of those costs.

The statistical basis of the analysis of highway costs that they devised is too complicated to be discussed here. Briefly, they recommended a combination of the gas tax and greatly increased license fees, the heavier vehicles to pay proportionately more than the lighter types. For example, under the plan proposed, the license fee for a six-ton truck would be equivalent to $525 per year at par exchange, and that for a ten-ton truck, $1,100 per year. In addition to this fee, there would be a gas tax equivalent to 13.5 cents per American gallon. In the opinion of the British experts, these levies constitute no more than the proper share that trucks should contribute for the use of the highways.

RAIL AND HIGHWAY OFFICIALS COOPERATE

What makes these conclusions doubly interesting to us in the United States is the fact that the members of the conference, beside its chairman, consisted of four prominent railroad heads and four equally well known figures in the highway transport industry. We are trying to do exactly the same thing in the United States today. The Association of Railway Executives recently appointed a committee of railway presidents to confer with authorized representatives of the automotive interests, including manufacturers and users, so that the two sides might sit down together, talk over matters in a give-and-take spirit, and endeavor to find common ground for legislation that will end abuse of the highways, terminate the disorderly and wasteful competition now prevailing, and protect both the railroads and the trucking industry in their own rightful provinces. While the exact personnel of the automotive committee has not yet been definitely fixed, it is assured that it will include men of high official responsibility, with mature experience in the basic needs of that industry. I am convinced that these cooperative efforts are a constructive move toward the stabilization of present unsettled conditions, and I am sure that they will prove successful.

The railroads are sometimes accused of trying to kill highway transportation by restrictive and destructive legislation. Nothing could be further from the truth. In fact, some states have adopted legislation that the railroads consider too drastic. What the railroads are hoping and expecting to effect as a result of these conferences is a reasonable and proper code of legislation for state and Federal enactment. Rail officials seek only equal terms and conditions of regulation as between trucks and railroads, and want these to be effected by legislation so eminently just and so completely in the interest of the public and of the legitimate trucking industry that no valid objection can be raised to it.

Let no one forget that the railroads themselves use trucks in what they consider proper spheres of service, and expect to do so on a larger scale in the future. They are not enemies, but friends, of the legitimate trucker and want proper legislation to shield him from the effects of destructive internal competition, as well as to protect themselves from that evil.

CONTROL OF TRUCKS AND RAILWAYS DIFFERS

It may be helpful if I attempt to summarize, very briefly, the great difference between the privileges enjoyed by, and restrictions and duties placed upon, trucks and those affecting railroads in this country. These differences may be classified, as follows:

1. Railroads must build and maintain their own rights-of-way; truck operators are permited to use rights-of-way that are publicly owned and have been built for public use and not for private gain.
2. In addition to furnishing their own rights-of-way, the railroads contribute hundreds of millions of dollars in taxes toward general governmental expenses. On the other hand, motor-vehicle operators feel that they have done their share when they pay part of the cost of building and maintaining the highways without making any contribution at all toward general governmental expenses.
3. Railroads pay taxes to every state through which they operate, as well as to the Federal Government, and in many cases to counties and municipalities; truckers frequently operate through a number of states on one license plate, and by carrying specially constructed gas tanks are enabled to buy their gasoline where taxes are lowest and avoid payment of the gasoline tax elsewhere.
4. Railroads spend many millions of dollars annually in eliminating highway crossings and in protecting others. The operators of trucks, however, though they are among the chief beneficiaries of such improvements, contribute little or nothing to this cost.
5. Railroads are prohibited by law from building a single additional mile of track without securing governmental authority; truck operators, with few exceptions, are at liberty to start or extend operations when and where they please, as long as they secure a registration plate for each truck in one state.
6. Railroads are not permitted to discontinue the operation of unprofitable lines without governmental permission, and must usually submit to long and expensive hearings. Generally speaking, truck operators may discontinue or suspend service overnight, and without any obligation to give notice.

7. Railroad operations are surrounded with every safeguard for the welfare of the public and the employee, and railroad employees are selected and trained under rigid rules. Those in train and engine service are given frequent and thorough physical examinations. Their hours of service are regulated in the interest of safety.

TRACTOR AND TRAILER FOR MOVING CONTAINERS OF LESS-THAN-CARLOAD FREIGHT OVER CITY STREETS OR HIGHWAYS

None of these practices is in effect with respect to trucks.

8. Railroad rates must be published and adhered to; they must be fair, reasonable, and non-discriminatory; and they cannot be changed without due notice. Railroads cannot bargain for business; they must accept all the traffic offered, to all destinations, and at published tariff rates.

For the most part, motor trucks are not bound by any of these restrictions, which are clearly for the public welfare. One of the most serious and unfair advantages enjoyed by trucks is their ability to pick and choose their traffic. The consequence is that they take the cream and leave the less desirable part to the railroads.

DEFINITE PROGRAM PROPOSED

The remedy for the existing situation is to establish in every state regulations adequate to accomplish the four main purposes explained in the following paragraphs:

1. Payment for highway use should be accomplished by establishment of a system of adequate charges. These should be apportioned according to the actual use of the highways by vehicles of varying sizes, weights, and kinds. Such a system will probably involve some recognition of the two factors of weight and mileage. In addition to paying adequately for highway use, vehicles should contribute, in taxes, to the general expense of government as the railroads are required to do.

2. Reasonable limits should be placed on the width, height, length, and weight of trucks. This is necessary to promote safety, to check the destruction of highways and bridges, and to reduce the cost of building new ones.

3. Freight "trains" should be barred from highways and, in addition, the excessive use of unwieldy trailers should be prohibited.

4. The reciprocity now allowed to trucks in many states should be limited. In the case of pleasure automobiles, reciprocity is a proper provision for the public welfare and convenience, and conforms to the purpose for which the highways were built. Trucks operated for profit should pay every state in which they run for the privilege of using its highways for private business.

While this program is one of state control, it should be supplemented by Federal regulation of interstate trucking. Congress has ample power for this purpose under the Commerce Clause of the Constitution.

SOUND REGULATION TO THE MUTUAL INTEREST

It is of interest to note that the substantial trucking interests, generally speaking, are not in opposition to legislation of the character outlined, and many of them are actively working for sound regulation. In hearings conducted during the spring of 1932, before the Interstate Commerce Commission, in its investigation of this subject and, again in the summer, in hearings on three trucking bills that were before the Pennsylvania state legislature, some of the most determined arguments in favor of regulation came from the heads of large trucking companies. The obstructionists, in most cases, represent the irresponsible elements in the industry—the wildcat trucker, the tramp trucker, and the truck peddler.

As a matter of fact, the absence of proper regulation, together with uncontrolled, wasteful, and destructive competition, hurts the trucking industry relatively more than it hurts the railroads, because of the rate wars that are continually going on. These wars are also having destructive effects in many important branches of production and distribution, where there is large use of transportation. These branches are feeling the injurious and disturbing effects of rate instability, secret rate-making, and discriminatory and preferential rates.

RAILROADS ACTIVE IN THE MEANTIME

It should be understood that the railroads, while advocating the legislation here outlined, are not sitting idly by, pending its enactment, with the idea that legislation is the only thing that will help them. On the contrary, they are meeting the situation very actively with improved service. They recognize that under certain local conditions the flexibility of the motor truck permits it to handle traffic economically and efficiently. They do not and cannot dispute that conclusion, as applied to certain localities and certain kinds of business; but, taking the freight business of the country as a whole and including mass transportation over long distances, the railroads yield to no other agency in their ability to perform the service most satisfactorily, from all three standpoints of cost, time, and dependability. This traffic they feel is rightfully theirs and they are going after it with all the ingenuity and resources at their command.

To this end, freight schedules have been shortened everywhere and, in some cases, cut virtually in half, permitting manufacturers, distributors, and dealers to keep their running supply of goods at a low and economical point. The railroads have also introduced many forms of new and more efficient equipment, including the steel container and the truck body, which have the advantages of portability and reduced packing requirements. They are also experimenting with box cars especially adapted for the transportation of automobiles, and with self-clearing cars for bulk commodities that cannot be exposed to the elements. Furthermore, they have put into effect a system of direct store-door collection and delivery of freight that gives promise of favorable results.

Many other plans and methods looking toward more efficient operation are now being actively studied by the railroads, both individually and collectively. I have complete confidence in the capability of the railway managers to take continued advantage of every available opportunity for healthy improvements in service, to the end that all the various forms of transportation may find their proper sphere in the general scheme of distribution.

Sewage Disposal for New Jersey Coast Resorts

Difficulties of Increased Summer Load and Effect of Ocean Disposal on Safety of Bathing Beaches

By C. G. WIGLEY

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, ATLANTIC CITY, N.J.

THE coast of New Jersey is a continuous succession of communities that have been developed for summer resort business. Since the normal resident population is increased from 10 to 15 times during the vacation months, a heavy seasonal load is thrown on the sewerage system. Preliminary treatment usually consists of sedimentation, followed by chlorination, and final disposal is by dilution either in the ocean or its tidal estuaries. Because of the ever-present danger of polluting the beaches and destroying the shellfish beds, the New Jersey State Department of Health has set up stringent regulations as to treatment of sewage and location of points of effluent discharge, and it keeps a continuous check on the resulting ocean pollution. This article has been prepared from the paper presented by Mr. Wigley before the Sanitary Engineering Division at the Atlantic City Meeting on October 6, 1932.

ALL the New Jersey coast from Sandy Hook to Cape May, a distance of approximately 130 miles, is below 50 ft. in elevation. This terrain varies in width from one to three miles in the northern part of the state and from seven to fifteen miles or more in the southern part.

Along this coast there are 52 municipalities mainly interested in and maintained by summer resort business. These form the summer recreational area for a large part of the inhabitants of the Middle Atlantic States, making the territory of vast economic importance to the state as a whole. According to the 1930 U.S. Census, the resident population of these 52 communities is over 170,000, the largest cities being Long Branch with 18,000, Asbury Park with 15,000, and Atlantic City with 66,000. In the summer this population is greatly increased, the total passing the half million mark. Long Branch then can boast of 40,000, Asbury Park of 60,000, and Atlantic City of between 150,000 and 300,000.

These estimates of summer population are very approximate, as the actual number in any particular place varies from year to year, week to week, and day to day, the peak being generally in the heat of August or over Labor Day. The estimates given are believed to be under rather than over the maximum actual population.

Where residential summer houses prevail, the summer population may be from 10 to 15 times the winter population. In other municipalities along the coast, the summer population may be from 3 to 10 times the winter population, depending on popularity, size, and accessibility. Some of the towns of a residential character have the aspect of deserted villages in winter, but in summer become active and busy communities, appearing to have a population comparable to that of apartment house districts in the larger cities.

SEWER SYSTEMS IN SHORE COMMUNITIES

Of the 52 towns along this shore, 38 have a sewer system and some form of sewage treatment plant. These plants have been installed for the purpose of preventing pollution of bathing beaches or shellfish producing beds in inland waters.

In the northern section of the coast, where the mainland rises in proportion as the distance from the ocean front increases, lateral or sub-trunk sewers are not a problem, as adequate grades are available. However, the design of the main collecting sewers presents a fine problem in economics, as several of the towns extend from three to eight miles along the ocean front, where the ground is practically level. How deep can a trunk sewer be put before it becomes economical to pump from the outlying districts? Or is it justifiable to construct two or more distinct sewer systems to be served by separate trunk lines and sewage treatment plants?

In the southern section, on the narrow sandy strip along the coast, the usual method has been to select a central pumping station or treatment site, from which trunk sewers are extended in both directions along the beach as far as can be done conveniently, and then to install another pumping station or establish another sewer system and treatment plant. Because the highest elevations are not more than 15 ft. above mean tide, sewer grades are kept as low as possible.

In the southern section, sewers are laid on grades as low as 0.10 ft. per hundred. For the most part they are placed in very wet sand, often on an insecure bottom of soft muck. In the past a very common practice under these conditions has been to place boards, either with or without piling, in the bottom of the trench and then lay the pipes on these, resting on the bells. The wet sand was supposed to flow underneath the pipe in a sufficiently dense mass to support the barrel. Many of the piles used were short pieces of 2 by 6-in. timber, driven into the bottom of the ditch with a maul. These varied in length from 18 in. for a sandy bottom to between 6 and 8 ft. for a muddy one. The piles were usually spaced on 4-ft. centers along the trench so that when the backfill was placed the boards between the piles were often depressed. The result was that many sewers were broken as soon as the earth was replaced in the trench and the full load of the traffic came on it.

In former days cracks in sewer pipes were not particularly dangerous, but with the coming of heavy auto trucks and the consequent vibration of roadway and ground, they were enlarged with serious results. The fine wet sand which poured into them was immediately carried away by the sewage to permit more sand to enter. In one instance, a hole about 25 ft. in diameter at the surface and about 7 ft. deep was formed by this means beneath the pavement. It was only good fortune that the heavily laden coal truck which finally caused the pavement to cave in, passed over without falling into the hole.

As the ordinary cement joint proved unsatisfactory where there was considerable wet work, a jointing material was developed which was composed of heated pitch and cement, usually in the proportions of one part of pitch to two of cement. The heated pitch and cement are mixed together until they have the consistency of soft putty. While the mix is still hot, the material is formed into a wedge-shaped ribbon and is then worked

into the joint space. Water is poured over the joint as soon as made, to cool it, or wet sand is placed around it to hold the jointing material in place. Old joints of this type that have been in the ground for 30 or more years have been found to be generally tight and in good condition.

SEWAGE TREATMENT ALONG THE COAST

Along the northern part of the coast, the only water into which treated sewage may be discharged is the Atlantic Ocean, as the inland waterways are non-existent or are very small and shallow, with a low volume of flow. This is unfortunate as it necessitates the construction of sewage works near the shore, where the property values are highest. In this section sewage settling tanks are generally constructed below roadways adjacent to the beach, and the effluent is carried at least a thousand feet out into the ocean by means of a submerged outfall laid on the ocean bottom. The beach slope is comparatively steep, so that at this distance from shore the water is from 18 to 22 ft. deep.

Depending on the configuration of the shore line and the variable terrestrial forces that influence tidal movement, the currents along a coast may be extremely irregular and complex and therefore cannot be accurately determined. It has been found, however, that in general the currents off the shore of New Jersey are either northward or southward and parallel to the coast, but frequently striking the beach at an angle of about 15 deg. As a result of float tests made by the engineering personnel of the State Department of Health to determine the path of the surface and deeper currents, three main conclusions have been reached: (1) that the sewage discharged into salt water rises to the surface and forms a spreading film which travels in the direction of the tidal surface currents; (2) that as the sewage spreads it mixes with the sea water and thus becomes diluted; and (3) that the surface sewage film may reach the surf, depending on the strength and direction of the surface currents.

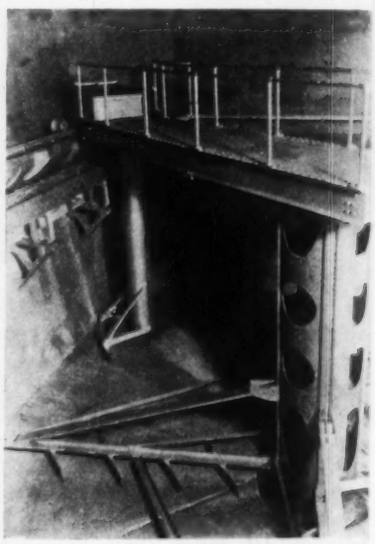
These results are borne out by other investigations of a similar kind, which tend to show that the sewage sometimes reaches the coast in waves, each wave being followed by an interval of apparently clear salt water. Presumably this is due to the fact that salt water and sewage do not readily mix. These facts are noted to illustrate the difficulty of securing a single representative sample for the purpose of determining the extent of pollution.

Prior to these investigations, it was believed that the general method of sewage treatment used, consisting of a sedimentation period of approximately eight hours, and discharge of the effluent a thousand feet out in the ocean, was entirely safe when the works were properly operated and kept in repair. Frequent inspections were made by the State Department of Health to see that accumulated solids in the tanks were regularly removed and that the outfall pipes were kept in good condition, as these pipes might easily be broken by storms and shifting of the sandy bottom, or might be worn away by the continual washing action of gravel and sand in the surf.

As the result of an extended series of investigations, the New Jersey State Department of Health in the latter part of 1928 passed a resolution requiring that the "minimum degree of sewage treatment at this time shall comprise the methods of sedimentation and chlorination, settled and disinfected effluent to be discharged into the waters of the Atlantic Ocean through outfall pipes, one thousand feet or more in length, from mean low water mark."

The effect of chlorination of the tank effluent was shown by later samples taken from the surf to reduce the B. coli content of 21 per cu. cm. before the installation of chlorine treatment, to less than 1 in 5 cu. cm. after.

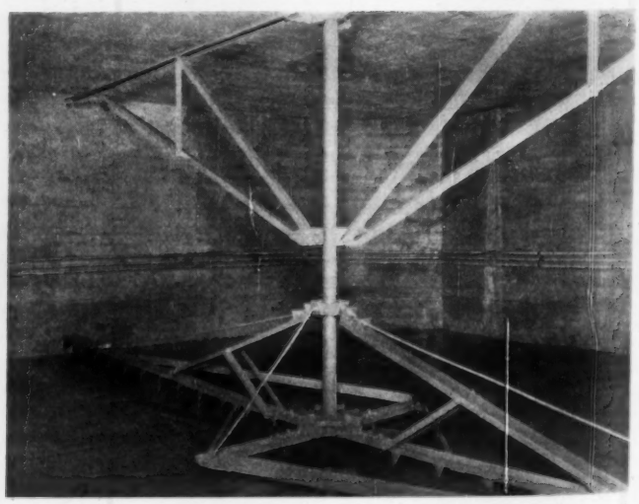
South of the municipality of Bay Head, which separates the mainland beaches from the narrow fringe of coast line, there are 17 municipalities having sewage treatment works, 3 discharging the effluent



An Empty Clarifier

Mechanical Bar Screen, Traction Clarifiers, and a Digester. Gases Carried Off Through Hollow Steel Flagpole

UNDERGROUND DISPOSAL PLANT AT SPRING LAKE, N.J.



Interior of Digester

into the Atlantic Ocean, and the rest discharging into inland tidal estuaries. The points of discharge are from one to three miles from the outlet of these tidal streams into the ocean. The method of treatment in all, except at Atlantic City, consists of sedimentation and disinfection. The sewage of this city is treated at three small plants by screening and disinfection, and at the main outlet works by sedimentation only.

The inland tidal estuaries of the South Jersey coast are natural shellfish propagating grounds, and there are some oyster beds leased in remote sections. In order adequately to control the resulting situation, the New Jersey State Department of Health has for many years kept in operation a power boat with complete laboratory equipment for a bacteriological study of various waters. Periodic investigations are made by qualified bacteriologists and chemists. As a result of more than 15 years of such work, large areas of tidal waters in the vicinity of populous sections have been condemned as sources of shellfish.

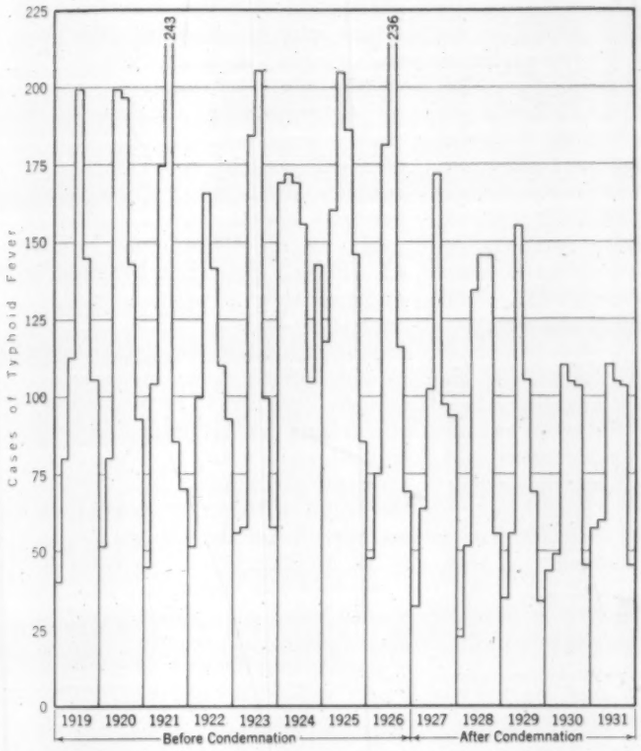


FIG. 1. SUMMER TYPHOID CASES IN NEW YORK, BY MONTHS Before and After Condemnation of Polluted Water for Bathing

Recent investigations by the Engineering Bureau of the New Jersey State Department of Health show that, where data can be obtained from sufficiently large population groups, there is apparently a relation between the number of cases of typhoid and paratyphoid fever and the pollution of beaches. It would appear that bathing in polluted waters should take its place as an important cause of the summer typhoid peak. Apparently the spread of infection in this manner is not of the epidemic type. The infections appear to be of a selective character, affecting only such persons as are peculiarly receptive hosts to typhoid bacteria or whose vital resistance at the time of infection is unusually low.

For example, consider the case record in New York City. In September 1926, the New York City Department of Health condemned certain New York Harbor waters and adjacent shores as bathing places. The chart shown in Fig. 1 shows the reduction in the number of typhoid cases reported from June 1 to November 30 for each year from 1919 to 1931. It is apparent that after this action was taken there was an immediate and material drop in the number of cases of typhoid fever. It is evident that bathing in polluted waters has a definite relation to the incidence of summer typhoid cases, and it is highly probable that many other diseases affecting the skin, eyes, ears, nose, and throat may be traced to the same cause.

SMALL SCREENING PLANT AND PUMPING STATION AT ATLANTIC CITY, N.J.

UNIQUE FEATURES OF TREATMENT PLANTS

At several of the sewage treatment plants along the coast, unusual features of design have been utilized. In many cases where settling tanks are constructed underground, ornamental flagpoles made of hollow steel are used for ventilation and removal of gases. In general, the flagpoles consist of a main staff 50 to 75 ft. high, open at the top. Often a wooden topmast is added to bring the total height to from 80 to 100 ft.

Recently, settling tanks with mechanical sludge-removal devices have been put into service at Spring Lake and Long Branch. The underground settling tanks at Asbury Park are fan shaped, having a larger cross section at the outlet end to produce lower velocities for the purpose of removing the finer suspended solids. These tanks have usually shown a very satisfactory record in removing sewage solids. The only plant along the coast where secondary processes other than chlorination are used, is at Bay Head. There the sewage is pumped inland. As no large quantity of dilution water is available, treatment is carried to the point of producing a non-putrescible effluent with sprinkling filters.

The settling tanks at the main Atlantic City plant are of novel construction, each tank having four hopper bottoms from which sludge is drawn every day or every other day, depending on the flow, and the sludge is run off into the baffled concentration tank, into which the floating surface scum is discharged continuously. From the concentration tank, the sludge is pumped direct to the sludge drying beds. Another novel feature is the further air drying of part of the sludge, its treatment by developing a growth of molds, and its sale as fertilizer. Most unfortunately this has been called a "green sludge process." However, it is adaptable to any type of sludge where it is desired to deodorize and dry the material quickly and economically for handling or for sale on a commercial scale.

An interesting feature of the plant at North Wildwood is the automatic sewage pumping station. Several pumps of varying size and capacity, each directly operated by a variable speed motor, are automatically accelerated, the pumps cut in or out, and the speed reduced, all by automatic electrical control.

The Refuse Problem of Washington, D.C.

Solved by Constructing Two Modern Incinerators of 595 Tons Total Daily Capacity

By HARRISON P. EDDY, JR.
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
METCALF AND EDDY, CONSULTING ENGINEERS, BOSTON, MASS.

WITH improved standards of municipal cleanliness and comfort, the question of proper disposal of refuse has in recent years come steadily to the fore. In Washington, D.C., the standard is particularly high, and hence the solution of the disposal problem there, as described in this article, is of unusual interest and value to engineers. This paper recounts the physical conditions involved and the limitations imposed, and describes the plants as finally constructed to handle refuse for the District of Columbia. It is abstracted from the somewhat longer treatment presented before the Sanitary Engineering Division at its session on October 6, 1932, at the Atlantic City Meeting of the Society.

PERHAPS the refuse problem of the District of Columbia is relatively of greater significance than that in some other cities because of local conditions. There is little industrial development, barring the plants of the public and city utilities and of the United States Navy Yard; there are many monumental public and private buildings and large park areas; and it is an attractive residential city with a large transient population.

Removal of garbage, rubbish, and ashes was formerly in the hands of private contractors, but during the three-year period ending in 1921 this service was taken over by the District of Columbia. About thirty years ago, the Washington Reduction Company built a plant for treating the garbage of the city at Cherry Hill, Va., about 25 miles to the south, on the Potomac River. Garbage was delivered to this plant by rail in steel tank cars. The District has finally taken over the contractor's plant, and its operation will probably be continued. In the past, ashes and street sweepings have been used as filling material on dumps, but hereafter the street sweepings will be burned in the new incinerators.

MUNICIPAL OPERATION ADOPTED

In 1919, a private contractor built a combined salvage plant and incinerator for dealing with the city's rubbish, or "trash" as it is called locally. In the next year, prices for salvaged goods fell sharply and the District took over the operation of the plant, leasing the property from its owners. Under municipal operation, the primary function of the plant was to dispose of rubbish, but the salvage operations greatly reduced the load on the furnaces. Nevertheless, even with 24-hour operation, the plant was inadequate to handle the rubbish collected by the District, not to mention that collected by private contractors, and much was burned in the open on dumps.

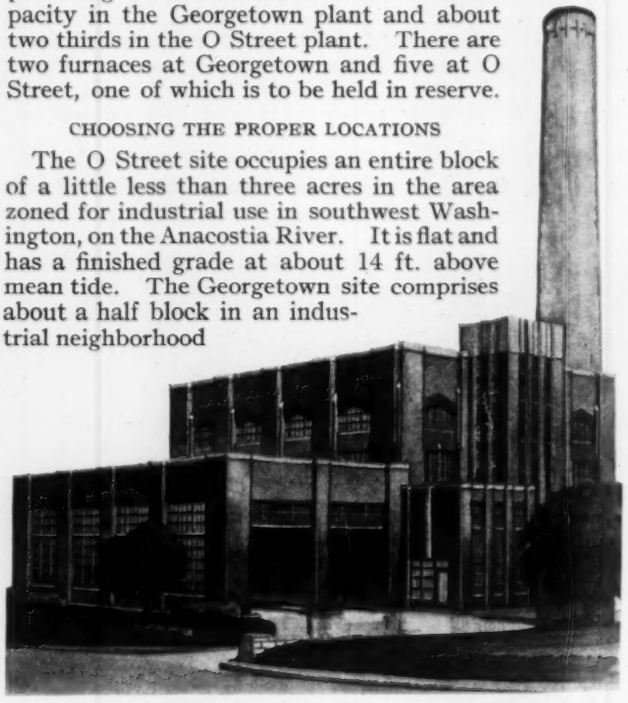
From 1922 to 1929 the District authorities agitated for the construction of incinerators, but it was not until the 1930 session of Congress that funds were made available. However, the sites had still to be approved by the National Capital Park and Planning Commission. This body refused to approve one site selected but finally approved two others, one at Georgetown and one at O Street. Many protests from groups of citizens were made, and many meetings with such groups were necessary. Finally, by patience and tact, Major D. A. Davison, then an Assistant Engineer Commissioner, succeeded in convincing the public that the two plants contemplated were necessary, that they would not detract from the desirability of the neighborhood in which they were built, and that they would end the noisome practice of burning rubbish in the open on dumps.

The act of Congress requires that the plants shall have the capacity to burn all "combustible rubbish and street sweepings" produced in the District of Columbia. In addition, permission is granted certain suburban communities in Maryland and Virginia to send their rubbish to the plants for disposal. Studies for determination of capacity included consideration of: (1) rubbish collected by the District; (2) rubbish delivered privately from business houses, hotels, and apartments of more than four families; (3) rubbish delivered by suburban communities; (4) street sweepings; and (5) leaves. The estimated weight of each class of material to be burned in 1930 and 1950 is given in Table I.

Together, the plants were designed to have a conservative rated capacity of 595 tons per 24 hours, 170 tons at Georgetown and 425 tons at O Street. The relative capacities were determined principally by forecasting the future geographical trend of the city's population in connection with current records for the various collection districts. These studies indicated the advisability of providing about one third of the total capacity in the Georgetown plant and about two thirds in the O Street plant. There are two furnaces at Georgetown and five at O Street, one of which is to be held in reserve.

CHOOSING THE PROPER LOCATIONS

The O Street site occupies an entire block of a little less than three acres in the area zoned for industrial use in southwest Washington, on the Anacostia River. It is flat and has a finished grade at about 14 ft. above mean tide. The Georgetown site comprises about a half block in an industrial neighborhood



GEORGETOWN INCINERATOR, LOCATED ON A STEEP HILLSIDE
Rubbish Bins Have Capacity of 25,000 Cu. Ft.

surrounded on three sides by negro dwellings. It is adjacent to a large power plant and a ready-mixed concrete plant. The site is on a steep hillside.

In general, the rubbish to be burned is highly combustible. Nearly half is expected to be paper or materials made from paper, but a substantial percentage is incombustible, such as metal and glassware. When delivered to the furnaces, the rubbish is very loosely packed so that its combustion will be rapid. In times of heavy rain, however, it will be very wet. Its heterogeneous character may be judged from the following list of basic constituents: rags, wood, leather, rubber, straw, metal, glass, china, and dirt—not to mention iron bedsteads, oil stoves, bicycles, automobile tires, fenders, and engines. Leaves may be either very dry, loosely packed, and quick burning, or they may have a moisture content as high as that of garbage.

TABLE I. DAILY WEIGHT OF MATERIAL TO BE BURNED IN THE DISTRICT OF COLUMBIA, IN TONS

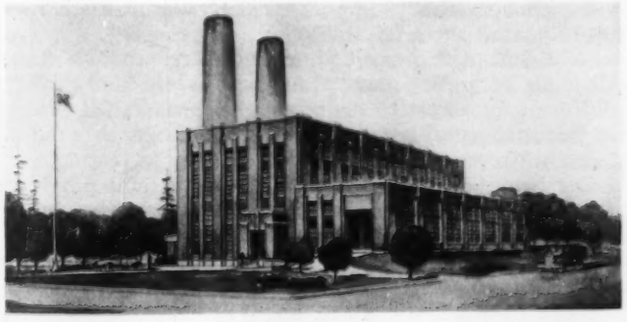
	1930		1950	
RUBBISH	Average	Maximum	Average	Maximum
Municipal rubbish	111	172	300	465
Business rubbish	132	205		
Suburban rubbish	8	12	19	29
Street sweepings	117	140	144	173
Total	368	529	463	667
Fallen leaves	117	...	144	...
Total including leaves	485	...	607	...

Bids for construction were taken twice. Since most of those first received exceeded the amount of the appropriation, economy of design was essential. This was effected principally in the basic furnace design, in the location of the auxiliary equipment, and in the simplicity of the buildings.

The collecting vehicles as they enter the receiving room pass over scales, and their weights are recorded in the weigh clerk's office near the entrance door.

HANDLING RAW MATERIAL

As shown in Fig. 1, the contents of the vehicles are discharged into a receiving bin after they have backed against the dumping curb at the edge of the receiving floor. The bins extend practically the full length of the buildings. Their capacities at the two plants are 50,000 and 25,000 cu. ft., respectively. Since deliveries of material are concentrated in a few hours of the day, and the furnaces are operated 24 hours a day, ample storage is necessary, though probably not more than enough for one day's collections.



O STREET INCINERATOR, IN SOUTHWEST PART OF WASHINGTON, D.C. Capacity of Rubbish Bins, 50,000 Cu. Ft.

Electric four-motor overhead cranes handle the material from the bins to the furnace hoppers by means of grab buckets. The cranes, of which there are two at the O Street plant and one at Georgetown, are operated from cabs fixed at the end of the crane girders directly over the bins. They are required to be capable of operating at not less than 350 ft. per min. for bridge travel, 200 ft. per min. for trolley traverse, and 140 ft. per min. for hoisting, and to perform continuously a certain definite duty at full load, at the rate of 35 cycles per hour.

Each hopper on the charging floor (Fig. 1) spans three charging holes of one furnace. The hopper sides are waist high to prevent operators (or spectators) from falling into the furnaces. One operator for each furnace keeps the material from clogging the opening into the container below. The hoppers expedite the spotting of bucket loads by the crane man and make it easier to keep the charging floor in a clean condition.

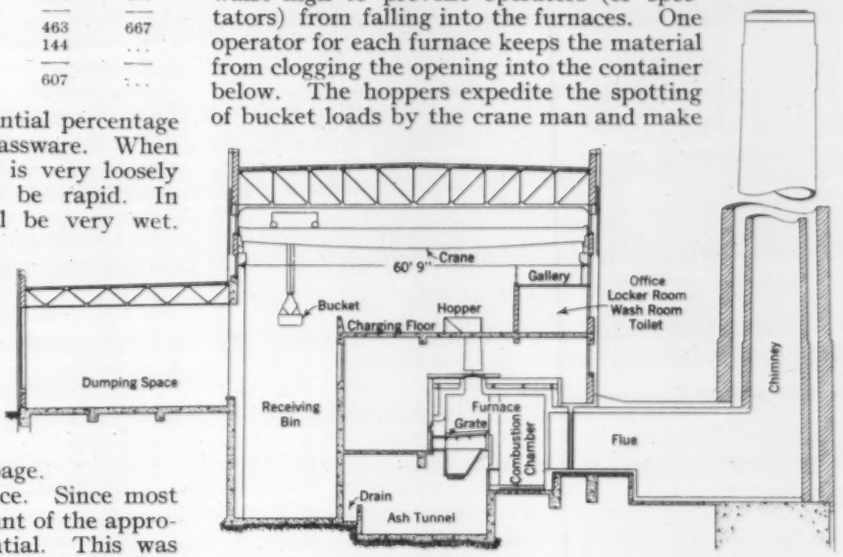


FIG. 1. CROSS SECTION OF THE GEORGETOWN INCINERATOR

The hopper terminates in three charging containers, each holding one charge of fuel and closed by steel doors, which retain the charge until its release is desired. Under the steel doors are charging gates with a refractory lining sealing the charging openings through the furnace roofs. The door and gate over any opening are operated synchronously by compressed air rams controlled by the fireman on the stoking floor. Provision is made for closing the charging gates tight, and for raising and lowering them at the beginning and end of their travel.

OPERATION OF PLANTS

Fuel is dropped directly on to fixed cast-iron grates; no drying hearths are provided. The sides and backs of the furnaces are protected by air-cooled castings, and the door openings, by air-cooled jambs and arches.

Each of the three cells of a furnace has independent charging equipment, ash pits, draft regulation, and ash-handling equipment. The grates are separated by cast-iron division bars. At the front of each cell is a large dumping section of grate.

Ashes are hoed forward over the dumping grate, the fireman working through small stoking openings in the guillotine doors at the front of the furnace. This protects him from the intense heat. The ashes drop through the dumping grate into large ash hoppers below. Each hopper has two continuously operated sprays for quenching and cooling the ashes and for supplying the water-sealed ash discharge gate with the water that keeps the ash pit air-tight. The principal object of the dumping

section, quenchers, and water seals is the elimination of smoke, dust, and gases from working spaces.

The ash gates are operated by oil pressure, controlled by four-way valves in the ash tunnel. At Georgetown, large motor trucks receive the ashes direct from the ash pits for delivery to the dump. At O Street the ashes are dropped into an electric trolley car, which tips

STOKING AISLE AND FURNACE FRONTS
Georgetown Incinerator (Construction Incomplete)

them into a semi-automatic skip hoist. This elevates them to the top of the ash bin, into which they are dumped for temporary storage pending their delivery to the dump in motor trucks. The capacity of the ash bin is 5,000 cu. ft.

DRAFTS AND COMBUSTION

During dry weather, it is expected that the furnaces will operate under natural drafts, much of the air for combustion being taken from above the grates, that is, through the stoking openings, the oil burner air registers, and the excess air inlet ports, although by opening the ash-pit doors at stoking-floor level, natural draft can be provided from below the grates. For use when necessary, particularly in wet weather, a forced draft fan is provided for each furnace. Air may be drawn either from near the top of the stoking room over the furnaces or from out of doors, as desired. Drawing air from within cools the room in summer but makes it uncomfortably cold in winter.

Fuel of the rubbish type burns with a long flame. Combustion starts in the furnace chamber (Fig. 1), and the burning gases pass over and across successive cells—the so-called "mutual assistance" principle—to the bridge wall at the rear of one end cell and thence into the combustion chamber, where the highest temperature is reached. The roof of the combustion chamber is level with that of the furnace, but its floor, 16 ft. lower, is about 9 ft. below grate level. The volume for combustion in this chamber greatly exceeds that in the furnace chamber. The flue leaves the combustion chamber halfway up, opposite the bridge wall. The short flues from each furnace are 6 ft. wide by 10 ft. high and terminate just outside the building (Fig. 1) in a larger manifold flue leading to the chimneys.

At O Street there are two chimneys, which are 120 ft. high and 10 ft. in inside diameter at the top of the lining. The single chimney at Georgetown is 165 ft. high above the foundation and 9 ft. in inside diameter at the top of the lining. All the chimneys have refractory linings for their full height.

At O Street there is a possibility of future utilization of steam or electric power. Since the amount of fuel burned is capable of generating considerable power, the chimneys were so located as to leave room for the future installation of boilers.

IMPORTANT AUXILIARY DEVICES

During dry weather, this fuel may burn at a temperature so high that it will be detrimental to the refractories. To keep the temperature down, excess "over-draft" air is admitted through an inlet port in the front wall of each furnace cell. This port is automatically operated from an indicating-controlling pyrometer by means of a motor and relay connected with the combustion chamber thermo-couple. The instrument is set to maintain a flame temperature between 1,400 and 1,600 deg. fahr. When the upper limit is exceeded, alarm bells ring in the stoking aisle and in the office, and a signal light flashes at the furnace.

Each furnace has its own indicating-controlling pyrometer, excess air-regulation equipment, and a 3-point ash-pit draft gage. Each plant has a multiple recording pyrometer showing the combustion chamber temperatures for all furnaces, a separate recording pyrometer showing chimney temperatures, and draft gages for the chimneys.

No air heaters have been provided, but to facilitate combustion in wet weather or when burning extremely wet fuel, each furnace has an auxiliary oil burner. The oil feed is obtained by an oil pump with a pressure tank mounted on the wall, and outside underground storage.

The overflow from the water-cooled dampers, compressors, and ash hoppers is collected in a central drainage trench under the ash-tunnel floor, and there are sumps at each ash hopper and a large sump and trap at the connection between the trench and the sewer. Drainage from the receiving bins passes through large trenches to the sewer. Provision has also been made for draining the dumping floor and the skip-hoist well.

For identification, the various piping systems have characteristic color stripes on the fittings. These systems include compressed air, fuel oil, high pressure oil for ash-gate operation, cold water, hot water, drainage, and steam heating.

Experience with wide and rapid temperature changes has indicated the advisability of using suspended arches for the furnaces, combustion chambers, and all flues. All loads of arches, fans, charging devices, and grating platforms for access to the top of the furnaces are carried by buckstays and not by walls. The flue arches out of doors are protected by corrugated asbestos roofing.

Conditions in such furnaces require careful provision for expansion of both the refractories and other brickwork. The expansion joints, which were given in complete detail on the construction drawings, provide for both the permanent change in volume of the refractories and the movements due to changes in temperature. Different types of joints were required in different locations in the furnaces, combustion chambers, and flue walls, arches and floors, and chimney lining. Some joints were temporarily filled with a material that would later burn out.

Both buildings are of brick and steel with concrete substructures, floors, and roofs. The necessity for a high clear space over the receiving bin prevented the carrying of floors or horizontal bracing across the entire main building. Hence, at O Street, resistance against wind pressure and racking due to the continuous use of

high-speed cranes was provided by the rather generous use of large knee braces, by extensive use of diagonal roof braces and both transverse and longitudinal roof trusses, and by two special braces above the stoking aisle.

At Georgetown, the foundations were simple, due to the close proximity of rock. At O Street, however, an old map showed that at one time the shore line had crossed the site. Piles had been driven to substantial depths at both the Navy Yard and the Sewage Pumping Station across the street. Numerous borings at the incinerator site showed filled material to an elevation of about zero or below, overlying clay, sand, and possibly mud lower down. Concrete piles were used, cast in place within corrugated steel shells, and designed for the maximum loading permitted by the building code, that is, 30 tons per pile, except that under the chimneys the pile loading was reduced to 25 tons each. There are 44 piles under each chimney and about 500 under the entire plant. The varying elevation from which the piles were driven probably somewhat retarded the driving operations. Difficulty was experienced in driving the corrugated shells more than about 30 or 33 ft.; so smooth steel pipe shells $^5/_{16}$ in. thick were used for greater depths.

Rigid economy was essential, but because of the communities in which the plants are situated it was necessary that their architecture should be pleasing and dignified. In keeping with the thought of incineration and upshooting flames, a vertical treatment was adopted and the brick pattern and other details were designed to carry out the same thought. This idea was also evident in the landscape treatment, in the grouping of tall pointed firs around the chimneys, and in the thorny tangle of Rosa Rugosa on the rugged hillside at Georgetown.

Both buildings have limestone trim. At Georgetown, the chimney foundation and the substructure, as exposed by the sloping hillside, are faced with granite. Copper panels, stained to imitate natural verdigris, cover the spaces between windows in the vertical bays.

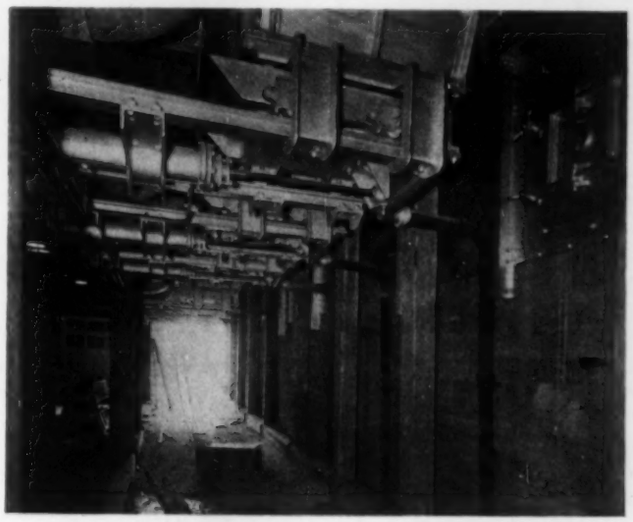
At each plant, sufficient land was available for effective planting. The landscape treatment was laid out in the office of Olmstead Brothers, at Brookline, Mass. In general, the plan was to provide an open setting for the buildings rather than to attempt to conceal them.

DISTRICT'S, RATHER THAN CONTRACTOR'S, DESIGN

Initially, specifications were prepared under which bidders submitted their own designs, subject to definite and comprehensive requirements covering all essential details of buildings and equipment. Under these specifications, bidders guaranteed the performance of their plants. With the specifications, the district issued certain drawings showing the location and general arrangement of the buildings and giving boring data and similar information. On March 17, 1931, ten bids were received on these drawings and specifications.

Following the complaint of one of the bidders, the Comptroller General of the United States rendered a decision to the effect that it was illegal to award a contract based on specifications that left matters of design to each bidder and that gave to the awarding officer the decision as to whether the bidder's design conformed to the specifications. After appeal by the District of Columbia, the Comptroller General reaffirmed his decision. Therefore it was felt necessary to have complete detailed drawings prepared showing a single design of each building, and of incinerators and appurtenances, as well as complete specifications. These specifications differed from the first set in that they applied only to the drawings for one particular design, upon which all contractors would bid. These specifications did not require the contractor to guarantee the performance of the plants. The capacity of the plants was determined by the engineer's design.

On December 8, 1931, bids for construction were received from 24 contractors, and later contracts were awarded to the two lowest bidders. The amount of these bids was $321,416 for the O Street plant, and $169,268 for the Georgetown plant, or a total of $490,684 for both. This represented a saving of $103,633 to the District of Columbia as compared to the low conforming bids first received.



GEORGETOWN INCINERATOR (CONSTRUCTION INCOMPLETE)
Ash Tunnel, Ash Hoppers, and Gates

The delay resulting from the Comptroller General's action prevented the award of contracts before the end of the 1931 fiscal year, when the appropriation lapsed. However, the funds were reappropriated at the next session of Congress, and contracts were awarded on February 3, 1932.

Before the contracts were awarded, a manufacturer complained to the Comptroller General that the designs prepared for the District excluded his equipment. The Comptroller General ruled that there was no legal basis for his complaint. Later it was claimed that the incinerators infringed a certain patent, but as yet no further action has been taken.

The contract time for completion of the O Street plant was 270 days and that for the Georgetown plant, 260 days. Both plants are now practically completed except for grading, cleaning up, "tuning up," and training the operating crews.

CONTRACTORS, ENGINEERS, AND COMMISSIONERS

The general contractors are the Rust Engineering Company of Pittsburgh for O Street, and the North-Eastern Construction Company of New York and Baltimore for Georgetown. The furnaces at O Street were built by the general contractors and those at Georgetown by the Standard Arch Company of Frostburg, Md.

Prior to construction, the work was under the direct control of Major D. A. Davison, then Assistant Engineer Commissioner. The construction was carried out under the Engineer Department of the District of Columbia, of which Maj. John C. Gotwals, M. Am. Soc. C.E., is Engineer Commissioner, and J. B. Gordon, M. Am. Soc. C.E., Director of Sanitary Engineering. The Designing Engineers were Metcalf and Eddy of Boston, Mass., and the Resident Engineer on Construction was A. B. Greene, Assoc. M. Am. Soc. C.E.

The Practical City Plan

As a Guide to Future Growth and an Inspiration to Ordered Progress

IT is said that ancient Babylon was one of the first planned cities, and that zoning regulations were not unknown in the old Roman laws. In the United States more than three hundred planning agencies are at work, the most extensive plan being that of the New York Region, which embraces an area of over 5,500 square miles. The two following articles were prepared from papers presented on October 6, 1932, before the joint session of the City Planning and Surveying and Mapping Divisions at Atlantic City. In the first, Mr. Arneson gives a summary of what a modern city plan should contain. In the second, Mr. Black points out the underlying errors in many planning projects and indicates the basic survey data and maps that are essential to the development of a successful city plan.

What It Should Include

By E. P. ARNESON

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

CONSULTING ENGINEER, SAN ANTONIO, TEX.

PARTICULARLY in the United States, ways of living change so rapidly that the city is hard pressed to keep in step with the tempo of the times. One district finds itself unsuited to a new era, becomes obsolete, and is abandoned to other uses, for which it is also unsuited and for which it was never intended. The use and value of land are ever changing, rising for a while to a zenith, and then declining to a nadir of virtual oblivion. The entire city will finally suffer the fate of its parts, although the reasons for the decline may not be the same. If a cure is found and applied, decay may be postponed. Otherwise, the city is doomed. This is a hard doctrine, but it is inexorable. The city-plan movement is a means of deferring the finale of the tragedy of the city. If a well designed city plan is adopted, there need be no great worry about the matter for a generation or two.

City planning is defined by Nelson P. Lewis as "Simply the exercise of such foresight as will promote the orderly and sightly development of a city and its environs, along rational lines with due regard for health, amenity, and convenience, and for its commercial and industrial advancement." A city plan calls the attention of the public to the way in which the city intends to grow, where it intends to obtain its water, and how it will dispose of its wastes.

STREET SYSTEM OF FIRST IMPORTANCE

Since the streets are the most permanent part of the city's structure, they crystallize the city plan. Proper design of the street system is vital. A few principles of ideal street location emerge from the record of American urban growth and from experience with motor-vehicle transportation. The inner sections of the town should be divided into rectangular and trapezoidal blocks, with their long sides pointed toward the business center. The streets that bound the short sides of the blocks will then run as the sides of a polygon, roughly concentric about the business center. Encircling this center, and in close proximity to it, there should be a by-pass street of more than ordinary width.

Diagonal streets, forming the greater traffic arteries, should cross the rectangular system. Beginning at the inner loop, they would radiate outward to the important sources of traffic. Other diagonals may connect remote parts of the city and pass to one side of the central traffic district. Still others should run along both sides of the railroads to serve as intercepting conduits for the blocked traffic. If the railroads are removed, the abandoned right-of-way would then be used as a diagonal street.

The blocks in the residential districts ought to be long—say a quarter of a mile—to reduce the number of street intersections and consequently the opportunities for accidents to vehicles and pedestrians. Since these blocks will then be inconveniently long for pedestrian traffic, they should be cut in two by a walk leading from one street to the other. The downtown blocks, where traffic is controlled, should be shorter, so that the cross streets can relieve the congestion on the longitudinal ones.

In the rear of residential lots, and through their centers, easement strips should be reserved from 5 to 15 ft. wide, for pole lines, sewers, and gas and water mains. This space may later be reclaimed for alleys, if the district changes in character so that it is assured that they will be well policed. Alleys back of detached houses are not advocated, because they have proved unhealthful, dangerous, and ugly.

Streets, of course, should vary in width with the expected traffic. Always excepting special conditions, 100 ft. is a reasonable width for the most important thoroughfares. If traffic demands a greater width, it may be wiser to open another street in the vicinity to help carry the load. Streets of intermediate traffic density need not be more than 80 ft. wide, and short residential streets may have a width of 60 ft.

The widths of sidewalks should be apportioned according to the amount of pedestrian traffic. Obviously, they may be narrower in outlying areas than in the business district. Considerations of both safety and beauty should guide in the lighting of streets. Power lines should be kept under ground.

Trees should be planted along the streets, back of the widest possible position of future curb lines. But tree-planting should be done by experts under unified control, and not in the haphazard, unscientific, individualistic manner that has prevailed in the past. Also, the trees should be selected to fit the surroundings. Slender-growing ones are best for narrow streets. A smoke-ridden town should have smoke-resisting vegetation,

while a dry country needs vegetation that can resist drought. Once trees have been planted, they should have the organized care of the municipality.

PROVIDE FOR RAPID TRANSIT

In the smaller cities and in the remoter districts of large ones, the street railway is waging a losing battle with the privately owned automobile. Where permitted, rapid transit companies are removing their outlying tracks and replacing them by motor buses.

For relatively short hauls the street railway is still the most successful method of handling large crowds in a short time. However, street cars cause congestion and endanger life by reason of their fixed course in the roadway and because they load and unload passengers in the center of the streets. The practice of city planners seems to be to consolidate the street-car lines and confine them to fewer streets, leaving the others free for automotive traffic.

Bus and car lines should be evenly distributed over the city so that passengers do not have to walk farther than about a half mile to reach one of them. All sources of heavy passenger traffic, such as the downtown section, railroad stations, ball parks, and recreation grounds, should of course be reached by rapid transit. A city well served by subways, street cars, and bus lines will grow horizontally—which is to be desired—and not vertically, in tenements and apartments.

HIGHWAYS FOR PASSENGERS AND FREIGHT

The motor vehicle is revolutionizing the movement of passengers and fast freight. The city planner should locate certain thoroughfares so that this new traffic can drive straight into the various destination centers. In addition, belt lines, loops, or by-passes, all more or less concentric, should be provided so that traffic en route to remoter parts of the city can avoid the congested sections. Moreover, the city planner will do well to project future routes exclusively for the use of motor trucks. This kind of freighting will grow to large proportions and will demand its own avenues, which may best terminate in the belt lines.

Highway engineering is fast becoming an important science in its own right. The laying out of highways involves numerous minor problems. Among these is the setting apart of land for intersections, traffic circles, grade separations, and parking places.

THE RAILROAD'S PLACE IN THE PLAN

Although the prosperity of the railroads is menaced by the newer forms of transportation, such as inland waterways, motor vehicles, and pipe lines, it is not expected that they are to be abandoned, and it is still necessary for the city planner to give them very earnest attention. The railroads interfere with the safe and convenient use of streets by blocking them with switching, or by the interposition of yards between important parts of the city. They also conflict with the best use of residential districts by causing noise, smoke, and unsightliness. The remedy for the blocking of streets—removal of the tracks to a suitable location—may also be the remedy for the residential nuisance.

It may be feasible to combine all the railroads on fewer rights-of-way, or even on one. If there are not too many railroads, a consolidated station, centrally located, may be the solution of the passenger traffic problem. As for switching yards and freight stations, they may be moved to the outer parts of the city. Remote locations for freight houses are not inconvenient in this day of quick delivery by motor truck over well paved streets. The consolidation of all railroads in a central freight depot is a modern tendency.

Then there is the almost universal case of a railroad's dividing the town in two. If removal of the tracks is out of the question, the choice then lies between grade separations at individual streets and wholesale separation by depressing or elevating the tracks. In any solution, property damages result, and these may be the chief item in the cost of the improvement. If the level of the tracks is changed, a disturbance of all commercial floor levels results, with consequent expensive rearrangement. The cost of remedying such a situation may be so great that the city must accept defeat at the start.

AIR AND WATER PORTS

Since it is evident that the airplane will some day carry the greater part of the long-distance passenger traffic, the city plan should indicate the position of the airports. Even in the present state of the art of flying, spacious landing fields are required. Further development of the autogyro, or a similar machine that can land in a small space, will tend to bring the airports into the city proper. Since this will upset the city planner's present views on landing fields, it would be wise for him to set aside areas close to the central district for such eventual use. In the meantime these spaces may be used as plazas.

The design of ports for inland waterways or for deep-sea shipping requires very specialized engineering knowledge. The matter is further complicated by the requirements of the U. S. War Department, by the draft of vessels, currents, floods and tides, and the character of freight. If water-front conditions permit, the principle to observe in locating a port is to place it where it will interfere least with the life of the city and where it will be readily accessible to railroads and motor vehicles.

WATER SUPPLY, DRAINAGE, AND WASTE DISPOSAL

It is becoming a settled policy for American municipalities to own and operate their own water supply systems. The city plan should designate, if only on broad lines, the source of the future supply and how it is to be brought to the city. The locations of reservoirs and elevated tanks within the city should also be indicated, because they affect the use and value of nearby land.

Provision for ridding the city of storm water should be made by the city planner. This may involve the important work of checking floods by means of a detention dam. The common method, however, is to designate the locations of proposed storm sewers. There is a growing tendency to avoid the use of storm sewers in outlying districts and, instead, to recommend that the city acquire the land occupied by natural channels. Storm water is then delivered to these channels by minor sewers and streets. Not only does the natural channel often furnish an economical means for the disposal of run-off, but the area, so set apart, has other uses. The park or open-space area is increased, and a dangerous or unsightly creek bottom is removed from the inhabitable area of the city.

The city plan should deal with the problem of waste. It will project sewer mains and propose a method of sewage disposal, whether by dilution or by treatment. If the latter method is chosen, the site for the treatment plant should be selected with regard to its effect on adjacent land use. Such plants are in bad repute with the average resident.

Methods of garbage disposal also merit the consideration of the city planner. If incinerators are to be employed, they should be so located that the smoke nuisance

and general unsightliness resulting from disposal will not affect the use of neighboring districts. Both sewage treatment plants and incinerators ought to be placed on the lee side of the town.

ZONING MAKES FOR ORDERLY GROWTH

People will be encouraged to improve their property if they are confident that the results of their labors will not be nullified by conflicting developments on neighboring land. There is not entire agreement as to what zones should be established, but the following list is fairly comprehensive: industrial and warehousing; downtown merchandizing; outlying merchandizing; residential, detached houses; residential, apartments; schools and recreation centers; and cemeteries. Selection of the location for these zones should be governed by considerations of maximum convenience to the users of the services and by minimum conflict between uses. The industrial zone, for instance, should be placed to leeward so that the prevailing winds will blow the smoke and odors away from the city. This is particularly wise in the Southwest, where oil refineries are a characteristic suburban enterprise. The industrial area should be of flat topography, in order to minimize the cost of grading for tracks and factory floors, and should have ready access to all the railroads of the city, to the street railways, and to the street system. Ample space of the same type should be available for factory expansion.

In planning, generous grounds should be allotted for schools. After a school has been opened, and the surrounding area has been closely built up, it is very expensive to enlarge the grounds. Since school buildings are relatively important architecturally, they should have enough land to set them off properly. Not only should the grounds be of sufficient size for architectural and landscape development, they should also contain about 100 sq. ft. for each pupil.

Schools should of course be served by rapid transit facilities and by the street system. But they should not be placed on arterial streets, because the students would then be exposed to danger in approaching and leaving the school and might be a hindrance to traffic.

Parks bring the country to the city. Beside their esthetic value, they are useful in allowing healthful light and air to enter the city abundantly. Moreover, many a conflagration has been stopped by a park. City planners now try to make a system of the parks, linking them together by boulevards, which are themselves treated as elongated parks.

The city planner should look for opportunities to make parks of ravines, rough ground, areas surrounding reservoirs, and otherwise useless land. Such spaces, in the hands of an artist of even ordinary inspiration, yield surprisingly beautiful results.

Cemeteries are difficult to locate. The best place for them seems to be outside the city in some attractive natural setting. The Romans buried their dead outside the walls and along their main highways. Today distance from the city does not constitute the objection that it did in the time of the horse-drawn vehicle. If the cemetery must be placed inside the city, a suitable horticultural screen will tend to make it less objectionable.

The public is beginning to feel that its more humble citizens are entitled to decent housing. Adequate grounds should be devoted to building projects so that ample light and air may be had by all. The proportion of land to buildings should be liberal to prevent undesirable density of population. It is within the province of the city planner to frame building codes to govern safe, sanitary, and fireproof construction, to limit the size and height of buildings, and to establish setback lines.

PRIDE IN CIVIC CENTERS

The city has always been a poetic personification of its inhabitants. The planner will recognize this feeling of civic pride by dedicating an area for a civic center. Adequate setting and space are also required as a background for public buildings, such as the governmental headquarters of the city, county, state, and nation, and libraries, auditoriums, and museums. Such buildings are usually architecturally pretentious and lend attractiveness to the city. The planner may find that there are too many such buildings grouped in one locality. To relieve this congestion, he may find it advisable to establish secondary centers, for which places may be found at the ends of avenues.

The city planner will need detailed information concerning his city. Although the following items by no means constitute an exhaustive list, they will prove essential to an intelligent study: a photographic air map of the city and its environs, to a scale of, say, 600 ft. to the inch; an accurate topographic map of the same region, with special maps of particular areas; climatological records of rainfall, direction of wind, and flood records; population and traffic counts; and an industrial survey.

MAKING THE PLAN EFFECTIVE

Conclusions and recommendations drawn from economic studies cannot always be put into effect. A civic improvement may be shown to be profitable, but it may exceed the resources of the public purse. A city plan will be put into effect slowly. In fact it must be flexible and easily adaptable to the exigiences of changing times. It will be executed in fragments.

The cost may be borne by taxation on a pay-as-you-go plan, by bond issue, or by direct assessment. The last method is growing in favor. The benefits of an improvement are assessed against the land benefited, and the city as a whole bears the excess cost, if any. This method is equitable, for there is no reason

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A SECTION OF AN AERIAL MAP
Useful for General Plan and Zoning Studies

why individuals should benefit by a public expenditure.

Many paved streets may come to the city at no direct expense to the taxpayers, when new subdivisions are placed on the market. The various utilities serving these additions may be added to the city's system at no public cost. Occasionally parks also will be given to the city as memorials. Patriotic societies will arouse public opinion to preserve landmarks and historic sites. In fact, such activities may be the beginning of a city plan. Once such a plan exists, it will have considerable weight. The burden of proving it unworthy will be on the opposition, which, in a democracy, will have to convince a disinterested citizenry. If the city plan is right, it will be honored.

Making and Using City Plans

By RUSSELL VAN NEST BLACK
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CITY PLANNER, NEW HOPE, PA.

ELEMENTS other than technical perfection frequently determine the fate of city plans, such as the attitude of administrations and the prevailing local point of view. Too many plans have failed simply because of lack of deep-seated interest in them or because of misunderstanding as to their purpose and use. Assuming, however, that the field is prepared and receptive and that the planner is confronted simply with the problem of producing a workable plan, what are the primary requirements and the method of procedure?

BASIS FOR PRELIMINARY PLANS

Too often a crude line map ten years old, U.S. Geological Survey maps of ancient vintage, made by wagon-wheel methods, and a handful of plot surveys on various and often inconvenient datums, are the only material from which to evolve a working plan for the development and expansion of a municipality. Such information, if not too inaccurate and if supplemented by other easily procurable data, may serve fairly well for the preliminary plan, setting forth by map diagram the general character and direction of future development and giving only the approximate location of future streets, parks, and school sites. But by no stretch of the imagination can a plan developed on such a basis be applied without extensive adjustment. It can serve only the incidentally worth-while purpose of a diagrammatic statement of principle.

If such a plan is founded on sound theory and good judgment, it may serve a very useful function as a general guide. In many communities it will constitute the best stepping stone to better maps and, later, to more adequate planning. Successful planning is still largely a matter of education both as to function and cost, and the preliminary plan is an important element in education. Its danger lies in misconception of the range of its application and intent. The planner should make it clear that his studies in this form are preliminary in character and that his plan is a picture to be used only as a general guide and as a basis for the more precise studies that must follow.

MASTER PLAN AND OFFICIAL MAP

A properly established planning program may be divided roughly into two parts, a preliminary or general plan and a final or working plan. In a number of states, recent planning legislation uses the terminology, "master plan" and "official city map," for these two steps, and these terms will be employed here.

The master plan may be defined as a general or guide plan that visualizes as clearly as possible development trends and requirements over an indefinite period of time, perhaps fifty years or more. On it projects are located only approximately. This plan is not officially adopted by the city administration, but is kept as the guide of the planning commission. It thus has the advantage of being protected by all the authority of the commission and at the same time remains more flexible than it would be if it were subject to enactment by city ordinance. This elasticity of the master plan is essential because of its long-range character. It extends through a long period of years and is subject to inevitable and unforeseeable shifts in the nature and trend of urban development. These must be met by easy adjustment, which is not possible if the status of the land has been legally fixed by the official adoption of the plan.

The official city map should comprise the existing city structure plus certain selected projects taken from the master plan. Opinions differ as to how inclusive this official map should be, but I believe it should show only those projects that are likely to be needed within a ten-year period and that are presumably within the city's financial ability to accomplish during that time. The official city map can be changed, but not easily. It is, in effect, a declaration on the part of the city that the projects shown thereon will be built, and it imposes a definite limitation on the quality and use of the land involved. It is assumed that, by its very nature, the official city map gives the definite location of the several projects shown and that they are based on sufficiently accurate survey data and detailed study to ensure workability without material later adjustment.

OBTAINING THE MAP DATA

Survey requirements for a city plan vary somewhat with the stage of its application. Essential data for the master plan include a wide range of factual and statistical material in addition to maps. The latter should include: (1) a line map on a scale of from 200 to 800 ft. to the inch, preferably in one piece, showing all existing public and semi-public improvements; (2) an air map or aerial photographic mosaic at the same scale as the line map, but capable of being enlarged by sections for more detailed studies and other special uses; and (3) at least fairly dependable topographic data. All general maps should include the surrounding area of influence at the city's periphery. Where the planning commission has jurisdiction over a prescribed radius beyond the city limits, the plan maps should include this area, or special, smaller scale maps should be made of it. Local maps should be supplemented by regional maps of the section, county, and state; by maps of neighboring municipalities; and by those showing all the planning proposals made by other jurisdictions that will in any way affect the local project. Naturally, the more complete and accurate these several maps are, the better.

The line map should be the result of a field survey rather than of the patching together of subdivision plats. Although it is not absolutely essential to the making of a creditable general plan, a precise topographic map on a scale of from 200 to 400 ft. to the inch will produce the better and more dependable results, especially under conditions of difficult topography with abnormally rugged or uneven contours. It may be that for financial or other reasons the making of such a topographic map must be left to the later stages of plan-making, but precise triangulation is nevertheless important to certain phases of the application of a master plan, especially the control of land subdivision, involving the knitting together of numerous individual land plats.

Some aspects of the plan, such as zoning, require special maps. The zoning use-of-land map should show all the variations in the use and type of property and structures that may be of significance in determining the form of zoning to be undertaken. It is rarely if ever necessary to show individual buildings and lot lines on the zoning maps. Such detail, if needed at all, is usually required only in small areas, and can be specially obtained. The air map, at a proper scale and supplemented by field investigation, can be made to serve the purposes of a zoning map quite satisfactorily.

The required supplementary physical data to be shown on these maps or in tabular form include street rights-of-way and paving widths; acreage of parks, playgrounds, school grounds, and other public properties; the extent and character of street improvements; and the extent of water and sewer services.

The more important factual and statistical data to be compiled include the following: history of the community and the locality; population, industrial, and commercial growth and trends; local habits, customs, and racial traditions; local practices as regards subdivision and real estate; traffic movement and parking provisions; housing conditions and requirements; and local public finances, including assessment and taxing methods, possible fluctuations in income, indebtedness, rate of debt retirement, customary expenditures for public improvements, and methods of financing such improvements. The degree of formality required in the compilation and presentation of this last group of facts will depend somewhat

FIG. 1. HIGH ACCURACY TOPOGRAPHIC MAP OF A PART OF EVANSVILLE, IND.
Type of Map Indispensable for Preparing the Final Plan or Official City Map.
Map by R. H. Randall Company, Toledo, Ohio

on the size of the city. In the small city of relatively simple physical and social structure, careful observation may be sufficient for some of these items, but all of them should be taken into consideration in the formulation of the master plan. Certain of these surveys, such as those for population and industrial and commercial trends, may be presented effectively in the form of diagrams.

Where the area is sufficiently large and important, it is good practice to start with development studies, that is, investigation as to the most desirable and most likely direction of residential, industrial, and commercial expansion. As well as can be foreseen from information in hand, the directional movement and extent of the city and of its various classes of land uses should be pictured for successive periods of ten, twenty, and fifty years. Past trends in local growth, national and regional trends, location, topography, climate, and numerous other factors, all have a bearing on the possibility and probability of future growth, as set forth in these expansion studies and to be provided for by plan. The results of studies regarding probable expansion and future use of land may be shown on the line map, but first they should be developed on the topographic and aerial maps by transposition from one to the other.

Evolution of a general plan should follow much the same course. With the expansion study as a basis, the general plan should first be sketched on the air map, then transposed to the topographic map for checking as to its practicability, and finally put on the line map preliminary to its final presentation. During the preliminary consideration of a plan—including conferences with the planning commission, the city administration, and to a certain extent with the public—it is desirable to have the plan rather carefully presented on all three mediums: topographic map, air map, and line map. After formal agreement on the composition of the plan, it remains only to present it in an attractive way by means of maps and a report, in a form that has both technical adequacy and popular appeal. The plan in this form then becomes the master plan.

MAKING THE OFFICIAL CITY MAP

The next step in plan making is the preparation of project plans. This may be done either for individual projects or, in a more or less wholesale manner, by making and adopting an official city map. This second step may be limited to the fixing of right-of-way lines for streets, and of boundary lines for parks, and the making of similar basic decisions for plan projects, or it may be extended to detailed construction drawings. The official city map usually does not go beyond the fixing of locations.

This second stage of plan making requires much more advanced and precise survey data than are necessary for the master plan. An accurate topographic map is indispensable. A carefully evolved five- to ten-year capital improvement budget, based on a thorough knowledge of city finances and showing projects and their costs in relative position and proper sequence, is highly desirable. Official city map projects should be selected from the master plan in accordance with their respective merits and timeliness as demonstrated by that plan.

Of the several maps and surveys suggested as prerequisites of intelligent planning, the only one especially difficult to obtain is the precise topographic map. This is because of its high cost, which alone frequently amounts to several times the usual cost of a complete planning program. The usefulness of topographic maps and precise surveys in fields of municipal activity other than city planning should be impressed upon municipal authorities. When available funds will not permit the mapping of the entire city area and this work must be done gradually, the most effective results will be obtained by precise triangulation as a first step. This should extend over the city and its outskirts and should be followed by topographic mapping of these outskirts and of other of the more rapidly changing sections of the city and its immediate environs.

BASE MAPS MUST BE ADEQUATE

No small factor in the failure of planning generally to receive the appropriations sufficient for topographic and other accurate base maps is the established relatively small cost to cities of their planning programs. It may be true that many city plans evolved to date are worth no more than they have cost. It is likewise probable that no city planning project has exhausted the possibilities of planning.

In many instances, municipalities would not have been justified in spending appreciably more time or money for planning studies based on the entirely inadequate available map data. It is as futile to attempt detailed planned studies on a flimsy map base as to use a micrometer scale on a chained dimension. The fault, therefore, in failure to make progress with a city plan, lies less often with insufficient planning appropriations than with failure to provide good maps, through the use of which greater direct expenditures on planning studies and city plans would be justified.

There are, however, further complications in this matter of the established low cost of city plans which may be lessening the success of planning efforts. The general benefits and economic advantages of planning claimed by city planners and others may seem too obviously out of proportion to the amount of money for which it is estimated the work can be done, to be convincing or even possible. To the uninitiated, the claims for city planning must sometimes seem to smack of charlatanism. The explanation of the development of this situation is simple. In the pioneer days of city planning the work for most cities was experimental. Large expenditures were not to be expected. Planners of necessity were compelled to make the best of what they could get and to proceed on almost any basis to get the work started. To a certain extent this situation still persists. Planning, as practiced, remains suspiciously cheap, costing less than any other engineering service, and it is regarded with proportionately less seriousness.

The interesting corollary of this situation is that the country has many worth-while preliminary city plans but few real city plans. Few real city plans have been paid for. Cities could hardly be expected, to pay for real plans so early in the development of planning understanding. Many excellent beginnings have been made, and probably no municipal moneys have ever been used to greater advantage than those spent on planning. Now, however, administrations must be urged to carry these plans further, upon better basic information. They must be educated to the fact that a successful city plan is the outgrowth of a process of evolution and that their tentative expenditures of relatively small sums have produced, not construction plans, but diagrams of forms and of principles which may be employed advantageously only by further and continuous development of plans for actual application on the ground. Planners can forward this necessary point of view by making clear the true status and function of such plans as they are able to produce with the available information and with the available funds.

Water Supply of Delaware County Menaced

A Battle Is Being Fought in Pennsylvania Against Encroaching Pollution by Sewage and Industrial Waste

By HARRY M. FREEBURN

ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
DISTRICT ENGINEER, PENNSYLVANIA DEPARTMENT OF HEALTH, PHILADELPHIA

FIG. 1. DELAWARE COUNTY, PENNSYLVANIA

ONE of the most rapidly growing residential sections of Pennsylvania is the eastern half of Delaware County fronting on the Delaware River (Fig. 1). Here also are found many industrial establishments. The proximity of this area to the City of Philadelphia and to the estuary of the Delaware River, which has been called the "Thames of America," up which William Penn sailed 250 years ago, has had much to do with the phenomenal development of Delaware County.

The beginning of the development in this section actually antedated William Penn by about 40 years, because the first settlements in Pennsylvania were made in Delaware County in 1643. The county underwent an early industrial development due to the water power afforded by the streams draining into the Delaware River. Iron forges and mills, ship building plants, paper mills, cotton and spinning and carding mills were established in the early days of the colony. The first railroad ever built in the United States was a gravity road made in 1809 by Thomas Leiper to connect his granite quarries with his ship landing on Crum Creek. The oil industry was first established in the lower part of Chester in 1881, when three refineries were constructed to produce paraffin oils, lubricating oils, gasoline, naphtha, wax, and asphalts.

According to U.S. Census data, Delaware County is the fastest growing county in Pennsylvania. A large part of this growth was caused by the exodus from Philadelphia following the general trend of population away from the cities and toward the suburbs. Improved highways and good rapid-transit and railroad service between Philadelphia and Delaware County were some of the factors that aided rapid expansion.

There are 47 minor civil divisions in Delaware County, which has a population density of 1,515 per square mile as compared to 15,242 per square mile in Philadelphia. The City of Chester, the largest municipality in the county, had a population of slightly over 59,000 in 1930, when the county's population exceeded 280,000.

Sewers had been constructed in a number of Delaware County communities prior to the creation of the Pennsylvania Department of Health in 1905. At that time sewage from many Philadelphia sewers was being discharged into Cobbs Creek, a small tributary of Darby Creek, which separates Delaware County from Philadelphia. During hot summer weather unbearable odors emanated from the creek, and it was covered with sewage scum for over half a mile above the dam near its mouth. In 1907 the Pennsylvania Department of Health issued an order to Philadelphia to prepare plans for an intercepting sewer along Cobbs Creek to eliminate the pollution of this stream. Decrees were also issued to the various Delaware County municipalities to prepare and submit to the State Department of Health for approval, plans of comprehensive sewerage systems and sewage treatment works. Approved sewer construction was carried out, but no sewage treatment works were constructed, and as a result stream pollution became more aggravated.

Although the Delaware River at Chester is over a mile wide and has a drainage area of 10,393 square miles and a mean tidal range of 5.4 ft., the discharge of untreated sewage from Chester and the other communities in Delaware County, as well as from Philadelphia, was a serious menace to Chester's water supply, which had its intake in the river itself. Nuisance conditions also existed in Cobbs, Darby, Stony, Little Crum, Ridley, Chester, and Hook creeks and caused numerous complaints.

By 1920 the City of Philadelphia had entirely completed the construction of an intercepting sewer along the east side of Cobbs Creek to a point near its mouth and had connected it with the sewers that had formerly discharged into the creek at many points. Because of the high-class type of the developments on the east side of Cobbs Creek in Philadelphia and on the west side of it in Upper Darby, it was later decided that for a proper solution of the sewerage problem of these municipalities the idea of constructing a separate sewage treatment plant in Upper Darby should be abandoned. Instead, a continuous intercepting sewer was constructed along the west side of Cobbs Creek to parallel the similar construction on the Philadelphia side. Cooperation having been secured between the Delaware County municipalities, their sewage was discharged into the Philadelphia sewers and will be conveyed to the proposed Southwest Sewage Treatment Works of the City of Philadelphia. Thus

IN Delaware County, which adjoins the City of Philadelphia on the southwest, the sanitary treatment of sewage and industrial waste before discharge into the Delaware River and streams tributary to it has become an absolute necessity. Through the efforts of the state authorities, 34 communities have formed themselves into cooperative groups and are solving the sewage disposal problem on six watersheds in the county. Notably in the case of Chester, which obtains its water supply directly from the Delaware River, there has been waged a half-century battle against turbidity, B. coli pollution, and vicious odor and taste. And recently salinity, due to encroaching sea water, has moved up the river. How these important problems are being solved is discussed in this article, prepared from the more complete paper read before the Sanitary Engineering Division on October 7, 1932, at the Fall Meeting of the Society, held in Atlantic City.

the first large cooperative sewerage program in Delaware County was finished in 1923.

The municipalities along Darby Creek have similarly cooperated in the construction of an intercepting sewer along that creek. The point of discharge is now in Darby Creek near its junction with Cobbs Creek. Industrial waste from several textile mills is still discharged directly into the stream.

By 1924 there were 35 public sewers in Chester discharging untreated sewage into Ridley and Chester creeks and into the Delaware River. In warm weather the septic conditions in these bodies of water created decided nuisances, and the sewage load on the Chester water works became very heavy, so that the Sanitary Water Board of Pennsylvania demanded the abatement of these nuisances. In 1925 the citizens of Chester approved a $2,500,000 bond issue for that purpose, this sum to be expended over a six-year period.

Sewage is about to be collected and pumped to an outfall at the lower edge of the city extending 1,771 ft. from the shore of the Delaware River, and located at a depth of 30 ft. The outlet point is 9,300 ft. from the water works intake. This contruction was based on a flow of 160 gal. per day per capita, plus industrial waste, plus 900 gal. per acre of infiltrated water, equivalent to 30 per cent of an annual rainfall of 41 in. Since it is a combined system, the sewers are designed to carry to the outfall a flow of 280 gal. per capita, plus industrial waste, and all flow over this amount during storms is diverted through the old outlets into the creeks and the river. A treatment plant is now being designed to remove settleable solids and to provide chemical germicidal treatment before discharge into the outfall.

SANITARY PROBLEM FACED ON WATERSHED BASIS

A concentrated effort was made by the Bureau of Engineering of the Pennsylvania Department of Health to secure cooperation between the various municipalities in Delaware County, to consummate joint watershed projects, and to eliminate nuisances caused by the discharge of raw sewage into the creeks. Representatives of the 34 municipalities first met in 1928, when an engineering board serving without pay was created to consider the sewerage problems of these municipalities. Trunk-line sewers were recommended, according to the general plan shown in Fig. 2, to include the numerous townships, villages, and boroughs covering an area of approximately 65 square miles.

The report of the Board of Engineers did not go into detail beyond that warranted by the general project, which required thorough cooperation between the towns along the streams in the county and called for the construction of continuous intercepting sewers to conduct the sewage to suitably located treatment works. Thus, in a comprehensive manner, the streams would be simultaneously restored to a clean condition and the development of Delaware County would be promoted at the minimum practicable expenditure of public funds and in a manner fair to all concerned.

DESIGN DATA FOR TRUNK SEWERS

In computing the various sewer capacities, it was assumed that the sewage, exclusive of infiltrated rain and ground water, would average 133 gal. per capita daily, assuming a consumption of 100 gal. per capita daily and run-off in 18 hours. The maximum flow was considered as 175 per cent of the average, equivalent to 233 gal. per capita daily. Infiltration of ground water was assumed as 2,000 gal. per acre daily.

The capacities of the trunk sewers were computed on the basis of the probable service demand in 1980, although it appeared that detailed studies might show it to be economical to reduce the capacities in some instances. However, it was recognized that, in general, as far as trunk-sewer design is concerned, very little money is saved by building a sewer designed for fifty years in the future with half its ultimate capacity.

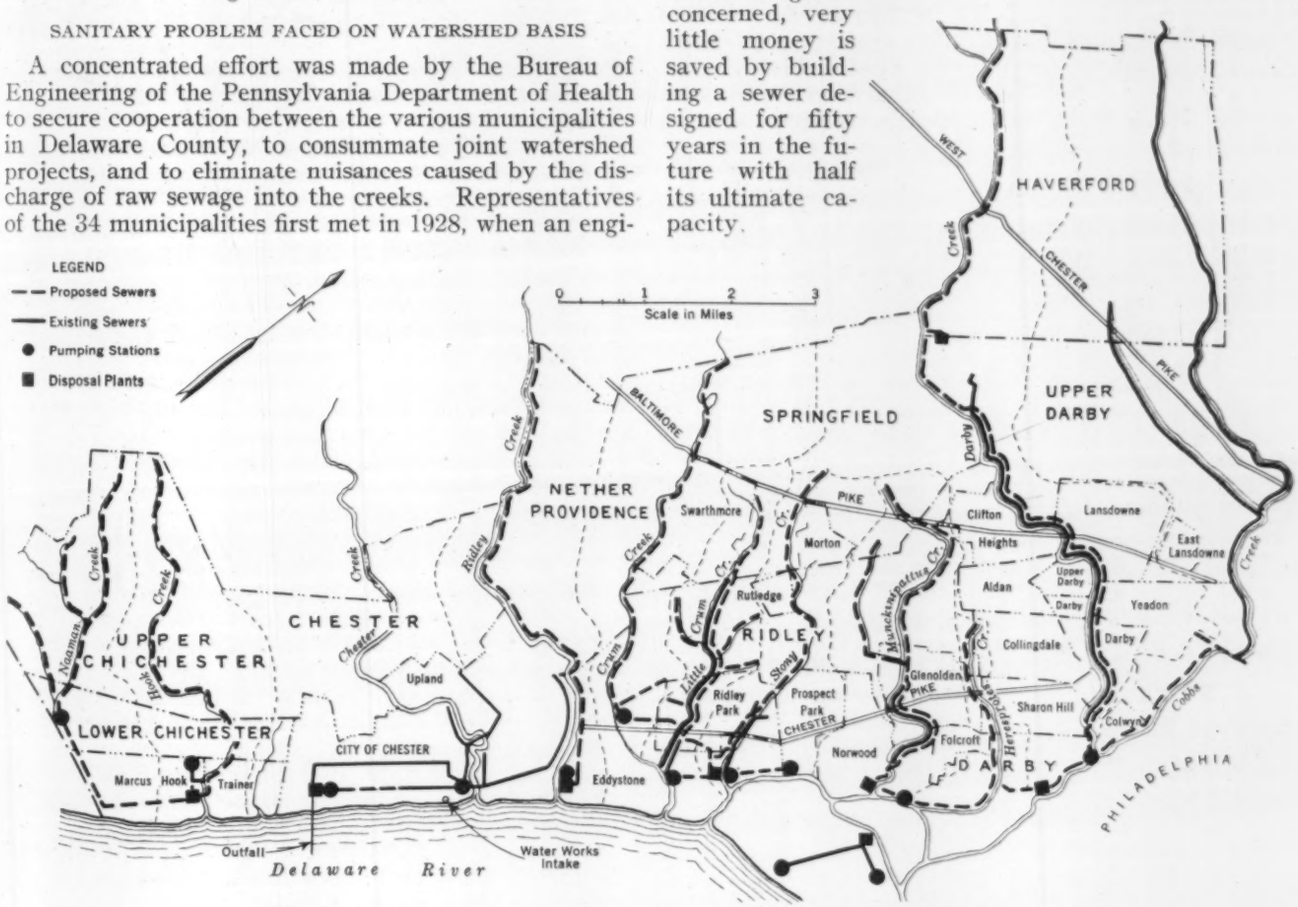
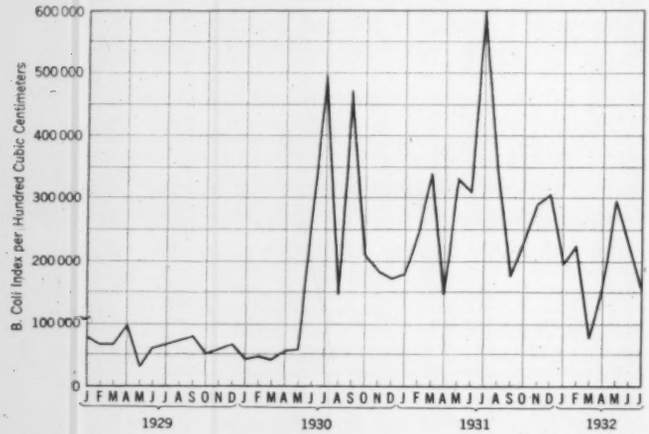


FIG. 2. MUNICIPALITIES AND DRAINAGE AREAS OF DELAWARE COUNTY
Showing General Plan for a Sanitary Sewerage Project

Available data on industrial wastes indicated that there were not many plants very far back from the Delaware River. The smaller plants would not contribute excessive flows and the large ones situated along the river would probably have to treat their own industrial wastes separately.

Under the plan submitted by the Board of Engineers for consideration, five treatment works would be required, as shown in Fig. 2, at the following locations: Plant No. 1, on the west bank of Darby Creek approxi-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B. Coli Index per Hundred Cubic Centimeters
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
1929
1930
1931
1932

FIG. 3. VARIATIONS OF B. COLI INDEX IN THE DELAWARE RIVER At the Intake of the Chester Water Service Company, Chester, Pa.

mately $1^1/_2$ miles below the junction of Cobbs Creek and Darby Creek; Plant No. 2, in Norwood Borough in close proximity to the confluence of Munckinipattus and Darby creeks; Plant No. 3, on the property of the Baldwin Locomotive Works, near the foot of Stewart Lane, south of Chester Pike between Stony and Little Crum creeks; Plant No. 4, in Eddystone, north of Seventh Street, between Eddystone Avenue and Ridley Creek; and Plant No. 5, in Marcus Hook Borough along Hook Creek, a short distance from its mouth at the Delaware River. The outfall sewers from Plants No. 1 and 2 would discharge into Darby Creek, but those from the other three plants would discharge into the Delaware River.

DEGREE OF TREATMENT REQUIRED

According to the 1922 agreement between the departments of health of Pennsylvania and New Jersey, Plants No. 3, 4, and 5, the effluent of which would be discharged into the Delaware River, should efficiently remove all settleable matter. In addition, Plant No. 4 at Eddystone, because of its proximity to the intake of the Chester water works, would treat the effluent with a chemical germicide.

As for Plants No. 1 and 2, to discharge into Darby Creek, which is tidal, they should remove settleable matter and oxidize the settled effluent. This degree of treatment was required on account of the large population that would be tributary to those works, the lack of diluting water, and the fact that the sewage would oscillate back and forth with the tides before ultimately finding its way into the Delaware River. In the future, the effluent from these plants may have to be treated with a chemical germicide.

It was recognized that the sewage from certain lowlands would have to be pumped to the treatment plants, and that all the sewage from some of the watersheds would have to be pumped prior to treatment. Nine pumping stations will be needed for this purpose.

The attention of the local authorities was called to the amount of capital and annual costs that would be required if ground water were admitted to the sewers. They were urged to make the necessary expenditures to secure tight, non-leaking sewers, since it was a good capital investment that would tend materially to reduce the annual charges as long as the systems functioned.

Estimates of cost were generally based on cost data for similar work in Delaware County and vicinity, covering a long period of years. Since the works at Plants No. 3, 4, and 5 were to accomplish partial treatment by screening and sedimentation, the board applied unit construction costs per capita ranging from $7.50 to $15, which were in keeping with engineering experience in American practice. The treatment afforded at Plants No. 1 and 2 would be equivalent to sedimentation and oxidation, and therefore the unit costs for them ranged from $15 to $25 per capita. The estimated total project cost for 1930 is shown in Table I.

TABLE I. ESTIMATED PROJECT COST FOR 1930

Trunk sewers	$1,783,000
Pumping stations	232,000
Force mains	149,400
Treatment works	2,852,000
Total construction cost	$5,016,400

The board did not submit detailed estimates of operating costs. However, it anticipated that the local authorities would be interested in such estimates and called attention to the fact that a group of sanitary experts, with many data available, recently had made a unanimous report in connection with the then pending litigation in the U.S. Supreme Court. The following is quoted from their report.

> Attention is directed particularly to the annual operation expenses which are absolutely necessary if the works are to function effectively. Such expenses, exclusive of such items as interest and contributions to sinking fund, are forecasted as follows:
>
> From $0.40 per capita per annum, for a population of 10,000 to $0.25 per capita per annum for a population of 100,000 for works to effect a reduction of 35 per cent in organic impurities. From $0.75 per capita per annum for a population of 10,000 to $0.40 per capita per annum for a population of 100,000, for works to effect a reduction of 85 per cent in organic impurities.

From $6 to $12 per mile of sewer per year was given as the estimate for repairs to sewers and appurtenances, and from $15 to $25 per mile of sewer per year, for cleaning and flushing.

Thus, a general plan for an adequate sewerage project, designed to have sufficient capacity until 1980, was accepted in 1931. Detailed plans are now being worked out by the municipalities on each watershed in cooperation with each other, and construction is now under way on various parts of the project.

PROBLEMS OF INDUSTRIAL WASTE

The principal classes of industry in Delaware County are metals and metal products, chemical and allied products, and textile and textile products, having production values in 1931 of $104,300,000, $57,800,000, and $44,600,000, respectively. The chief products are motor vehicles; railroad engines; machinery and parts; gasoline; lubricating oils and greases; and silk, rayon, and cotton yarns and thread. In 1931 there were 320 industrial establishments in the county, employing 37,822 persons and producing products valued at $253,598,000.

A large part of Delaware County is supplied with water by the Philadelphia Suburban Water Company, which serves an approximate population of 168,700 persons residing in 19 boroughs and all or part of nine townships. The water is taken from a 162,000,000-gal. impounding

reservoir on Crum Creek, located at a point six miles above the mouth of this stream where it joins the Delaware River.

WATER SUPPLY PROBLEMS

One of the main problems faced by this company was that of meeting the demands of the rapidly growing territory. To obtain additional water, another impounding reservoir with a maximum depth of 60 ft. and a capacity of 3,500,000,000 gal. was recently constructed on Crum Creek about three miles upstream from the existing works, at a point where the stream has a drainage area of 21.3 square miles. The water is passed through gravity filters having a gross capacity of 20 m.g.d.

The Borough of Media maintains a pressure-type, rapid sand filtration plant along Ridley Creek at a point about six miles back from the Delaware River. It supplies water to about 9,700 persons. The average daily consumption of the communities supplied is about 750,000 gal., or 77 gal. per capita. In the near future Media will have to modernize its filtration plant and provide additional capacity.

OBJECTIONABLE TASTES AND ODORS AT CHESTER

In the City of Chester and vicinity the drinking water, which is supplied from the Delaware River, has the reputation of having disagreeable tastes and odors. This is not surprising, for objectionable odors, varying in character and intensity, are present at all times in the Delaware River in the vicinity of the Chester water-works intakes. The principal odors, which vary with tide, wind, and temperature, are oily, oily-musty, oily-sewage, and sewage.

In 1931 a cooperative survey by the Chester Water Service Company and the Pennsylvania Sanitary Water Board located the sources of these objectionable tastes and odors in the industrial wastes from certain oil refineries, coke works, gas plants, chemical works, and paper companies. The offenders are installing systems to reduce or eliminate their decidedly aromatic and disagreeable waste materials from the waste water discharged into the streams.

The Chester Water Service Company supplies water over an area of 59 square miles, through 136 miles of pipe line, to approximately 80,000 persons, or about 27 per cent of the total population of Delaware County. The average daily consumption per capita in 1931 was 75 gal. There are two intakes in the river, one 42 in. in diameter and one 30 in., which are distant 422 ft. and 527 ft., respectively, from the water company's wharf. They are protected by screen boxes.

Some idea of the amount of water used by industrial establishments in Chester and vicinity may be gained from the records of the water company, which show that the average amount of water served for this purpose is about 782,000,000 gal. per year. A number of industries, beside using water from the public supply, take water direct from the Delaware River. It is estimated that some of the plants pump as much as 12,000 gal. per min. from the river. One plant, at times of maximum demand, pumps 18,000 gal. per min., of which 75 per cent is used as process water.

The Chester Water Service Company has two exceptionally difficult problems: first, to secure safe drinking water from the Delaware River, which at Chester has a very high bacterial and organic content; and second, to supply a palatable water that is free from objectionable tastes and odors.

The first public water supply for the City of Chester dates from the year 1867. Since that time the history of the domestic supply has been marked by a continuous struggle against turbidity, B.coli contamination, bad odor and taste, and salt water encroachment. Filtration and chlorination have been effective against the first two of these evils.

NEW FILTER PLANT BUILT

In 1920 the Chester Water Company built a new filter

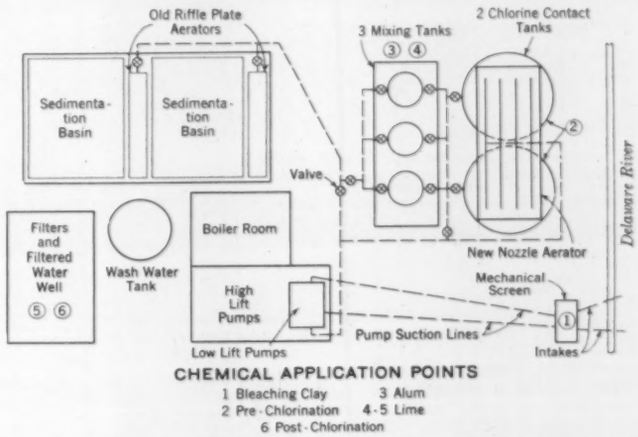


FIG. 4. DIAGRAMMATIC PLAN OF THE WATER FILTRATION PLANT AT CHESTER, PA.

plant on the Delaware River at Front and Fulton streets, at the company's intakes. In this plant alum was applied to the water before it passed over riffle-plate aerators, and into the sedimentation basins. The 12 rapid sand filter units, operated by gravity, had a total area of about 0.10 acre and were capable of filtering $12\frac{1}{2}$ m.g.d. After leaving the filters the water was treated with chlorine gas. In 1924, because of the tremendous bacterial load, the water was also prechlorinated.

As shown in Fig. 3, the B. coli content of the Delaware River at the intakes is very high. During the past three years the lowest monthly average B. coli index per 100 cc. was 27,400, as of May 1929. The maximum monthly average B. coli index of 601,300 occurred during July 1931. For 1931, which had a monthly average B. coli index per 100 cc. of 290,000 in the raw water, the average dose of chlorine was 1.84 p.p.m. The average prechlorination dose was 1.49 p.p.m., and that for postchlorination was 0.35 p.p.m.

By the time the conglomerate mixture of industrial wastes from such plants as oil refineries, paper mills, textile plants, and dye works reaches the intakes, it is mixed with sewage and diluted to such an extent that thus far it has been impossible to determine by analytical methods the constituents that are present in sufficient quantities to be noticeable to the sensitive organs of taste and smell.

PRECHLORINATION AND AERATION CONSIDERED

For some time it had been accepted as a fact that prechlorination and aeration would reduce the tastes and odors at Chester, and that these treatments should be included in any improvements to the plant. Experiments with rapid sand filters using alum and lime for coagulation, with prechlorination after a detention period of a half hour, and without such prechlorination, showed that the method without prechlorination effected a much better reduction in oxygen consumed, odors, and bacterial content. Starting with a B. coli index of 19,000 per 100 cc. in the raw water, the system without prechlorination produced a filter effluent having a B.

coli index of 22 per 100 cc. as compared to one of 4 with prechlorination. Odor intensities were lower when the water was prechlorinated.

Experiments for taste and odor were made with activated carbon filters operating at various rates, with both upward and downward flow. The results demonstrated that if the effluent from the existing filter plant were passed through carbon filters, operated at the rate of 2

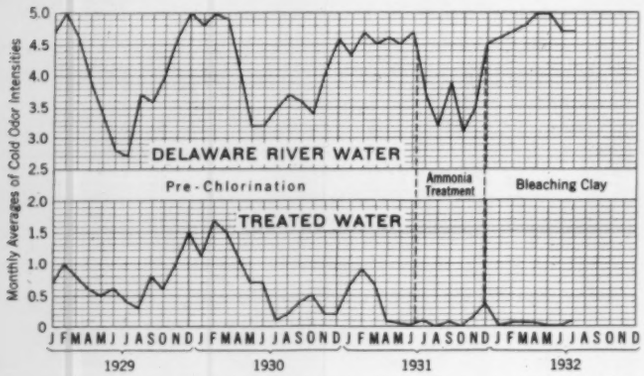


FIG. 5. ODOR REMOVAL BY DIFFERENT CHEMICAL TREATMENTS
Delaware River Water at Chester, Pa.

gal. per sq. ft. per min., a tasteless and odorless water could be produced 95 per cent of the time. Since such a system had never been attempted on a large scale, it was considered more or less experimental and it was not adopted. Incidentally, it would have involved a considerable expenditure.

As a result of continued experiments and studies at Chester, it was demonstrated that the best and most practical method of improving the taste and odor of the water was to improve and expand the existing plant to do the work.

RECENT CHANGES IN CHESTER WATER PLANT GREATLY IMPROVE PALATABILITY OF SUPPLY

It was decided to place a mechanically-operated, self-cleaning curtain screen in the existing suction well and fill in the part of the well not taken up by the screen and pipe lines to prevent the deposition of sediment, as shown in Fig. 4. The screen was needed to protect the nozzles of the new aerator. Two new low-lift centrifugal pumps were installed to deliver the raw water to the higher elevation required by this aerator, which was built to aerate the water prior to chemical treatment and sedimentation. It consists of 78 nozzles operating under a head of 5 lb. per sq. in. and having a capacity equal to that of the filters already installed, that is, $12^1/_2$ m.g.d. After passing the nozzles, the water is prechlorinated, held in two chlorine contact tanks, and then dosed with both alum and lime in three mixing tanks before it goes to the original riffle-plate aerators shown in Fig. 4. These improvements have been in operation since the middle of 1930.

Although improvement in both taste and odor resulted, as indicated in Fig. 5, it was not as much as would be expected. Doses of activated carbon ranging from 0.1 grams per gallon to 2.0 grams per gallon were then applied on the tops of the filters, to the effluent from the sedimentation basins, and to the water just before it entered the chemical mixing tanks. For the removal of the peculiar Chester taste and odor, sometimes termed "shoe polish," as much as 3 grams per gallon was required. Besides being very expensive, such doses clogged the filters.

Super-chlorination to as much as 6 p.p.m., and dechlorination with sulfur dioxide, were unsuccessful because the filtered water then had a sulfonated-oil taste and odor. Between July and November 1931, ammonia was applied to the water in the screen chamber prior to prechlorination with good results, as can be seen in Fig. 5. Experiments with bleaching clay gave promise in the laboratory, and it was therefore used on plant scale as a substitute for the ammonia treatment, with the point of application at the screen chamber in the intake well (Fig. 4).

At the Chester plant, the application of absorbent clay, besides effectively removing taste and odor, has aided in decreasing color, in assisting coagulation, in retarding decomposition of sediment in the settling tanks, and in removing some phenols. Although odors in the river water have been very pronounced every winter, few were present in the treated water during cold weather in 1931 and 1932, when bleaching clay was being applied. This was the first winter that consumers did not register many complaints of tastes and odors in the delivered water. The clay has slightly increased the chlorine demand and has made it difficult to hold down dust.

After the new mixing tanks were installed, it was found that in cold weather the floc was broken up when the coagulated water passed over the riffle-plate aerators on its way to the sedimentation basins. After this discovery was made, these aerators were removed.

Following the drought of 1930, salinity increased in the tidal estuary of the Delaware River to such an abnormal extent as to very much disturb the officials of the Chester Water Service Company and those of numerous industrial establishments dependent on the river as a source of supply. To date an enormous mass of scientific data has been accumulated regarding this problem, and the study is still in progress. Facts are gradually being established, but much still remains to be done. Final judgment must be reserved until the completion of the survey.

FUTURE WATER SUPPLY MUST COME FROM UPPER DELAWARE AND LEHIGH RIVERS

It seems obvious that the Delaware River at Chester will eventually become unfit for use as a public water supply and, as a matter of fact, it has almost reached that state now, on account of heavy pollution by sewage and industrial waste. Although the condition of the river will be improved by the treatment of this sewage and waste, pollution can never be eliminated entirely, and it will gradually become greater as the population grows and industrial development on the watershed increases. Also, the public has been demanding, and will continue to demand, higher standards for drinking water; and if for no other than esthetic and psychological reasons, it will insist that the Delaware River at Chester be abandoned as a source of water supply.

It has been estimated that the population of eastern Pennsylvania in 1980 will be about 5,000,000 and at that time, or before, it will no doubt be necessary for Philadelphia and the surrounding metropolitan territory, including Delaware County and other outlying sections in Pennsylvania, to abandon most of the present sources of water supply and to develop the tributaries of the upper Delaware and Lehigh rivers, so that the entire district can be supplied from these sources. If it becomes necessary for Chester to abandon the Delaware River before the development of a metropolitan water supply for eastern Pennsylvania, it would be possible, but costly, to construct impounding reservoirs on Chester Creek or on Ridley Creek, or possibly on both streams.

Economics of Proposed Highway Expenditures

Presenting a Method of Analysis to Determine Whether a Given Improvement Is Justified

By Thomas R. Agg

Member American Society of Civil Engineers
Dean, College of Engineering, Iowa State College, Ames, Iowa

TODAY highway expenditures bulk so large and are subject to such close scrutiny that it is becoming increasingly important to find some measuring stick of their value. Dean Agg here presents a method whereby a proposed improvement can be analyzed to determine whether the required expenditure is economically justifiable. This paper is abstracted from the more extended treatment presented before the Highway Division on October 7, 1932, at the Society's Fall Meeting in Atlantic City.

ALTHOUGH it is recognized that in certain types of highway improvement the dominating purpose is the removal of the accident hazard, most construction projects should go forward only when they are justifiable on economic grounds. Annual cost is the criterion by which to determine whether a proposed highway improvement is economically justifiable. Although in certain cases such an improvement may result in a lower annual cost of road maintenance, most major projects must also result in a lower annual cost of transportation if they are to be justified on economic grounds. This cost consists of two elements, road cost and vehicle cost. While certain types of improvements may actually increase the annual road cost, they decrease the annual vehicle operating costs sufficiently to more than offset this increase.

In manufacturing, the efforts of management are directed toward the production of a particular commodity at minimum cost. Improved machinery or changed methods of production are introduced only after an exhaustive study has been made to determine their effect on the cost of production. In the same way the probable costs of transportation before and after a proposed improvement must be estimated within reasonable limits. The results then indicate quite conclusively whether or not the expenditure should be made.

In the development of the necessary theoretical basis, the starting point is the simple statement that:

Highway transportation costs = highway costs + vehicle costs

This equation may be expanded somewhat as follows:

Cost of highway transportation per vehicle mile, on a specified highway = highway costs per vehicle-mile of traffic + cost of vehicle operation per mile of travel ... [1]

The highway costs must include all costs incident to the construction, maintenance, and administration of the highway. They may be expressed as follows:

Annual highway costs = interest on the investment + annuity to cover depreciation + annual cost of routine maintenance + annual administration costs + annuity for periodic repair at intervals of n' years + annuity for periodic repair at intervals of n'' years ..... [2]

It should be obvious that Equation 2 may be expressed in any unit desired. For most purposes it will be convenient to reduce results to the annual highway cost per mile per unit of traffic.

These relationships may be rewritten as:

$$C = Ir + \frac{(I - S)r}{(1 + r)^n - 1} + M + A + \frac{E'r}{(1 + 4)^{n'} - 1} + \frac{E''r}{(1 + r)^{n''} - 1} \cdots\cdots [3]$$

where

C = annual cost of any section of highway surfacing

I = initial cost of surfacing, including engineering and overhead

r = rate of interest, expressed as a decimal

S = salvage value of surface when superseded by another type

M = annual maintenance cost for routine work

A = annual administrative costs

E' = periodic maintenance performed and paid for at intervals of n' years

E'' = periodic maintenance, performed and paid for at intervals of n'' years (of a different character from those designated by E')

It is to be noted that in all ordinary cases the factor A can be omitted without significant error. It would be included in special cases, such as the Holland Tunnel and certain toll bridges.

A little consideration of Formula 3 will disclose the fact that it provides a means of estimating the annual cost of the maintenance of a road surface in standard condition for a long period in the future, as well as of determining the cost of a specific job already completed. An equation of like form will show the annual cost of each of the additional elements, such as drainage structures, retaining walls, elevated structures, tunnels, earthwork, guard fences, and warning and direction signs. However, it will be found that some of these elements have such long life expectancies that no appreciable error will be introduced if they are considered to have unlimited life under proper maintenance. Other elements, such as guard fences, may be considered to have unlimited life under proper maintenance even though each unit may be completely replaced piece by piece within a comparatively few years.

Obviously, the annual cost, C, can likewise be reduced to C_a, the annual cost per mile per unit of traffic. This is comparable to the toll that would have to be exacted if the highways were a private enterprise and were operated to give the investors a return at the rate of r per cent per annum.

The cost of vehicle operation may be arrived at by an analogous process. A formula can be developed by inspection of Equation 3, as follows:

$$C_v = I_v r + \frac{(I_v - S_v)r}{(1 + r)^n - 1} + O_v + M_v \ldots [4]$$

where

C_v = annual cost of vehicle use

I_v = cost of vehicle

S_v = salvage value of vehicle, end of its useful life

r = rate of interest, as previously defined

O_v = annual operating cost of vehicle, including tax imposts—a considerable part used for road maintenance and improvement

M_v = annual maintenance cost of vehicle

Having computed C_v for a vehicle, the cost per mile of travel is readily obtainable. The cost of transportation for any vehicle is equal to the road cost per mile per unit of traffic, plus the vehicle cost per mile of travel, minus the contribution per mile of travel that has been made to road funds, since that is already charged to transportation in the road costs.

ROAD TYPES AFFECT OPERATING COSTS

Certain estimates of the relative cost of vehicle operation were developed in 1928 as an outgrowth of a series of investigations of the various factors involved, and published as Bulletin 91 of the Iowa Engineering Experiment Station. The significant results are given in Table I, as follows:

TABLE I. RELATIVE COST OF OPERATING AN IMAGINARY "AVERAGE" AUTOMOBILE ON VARIOUS CLASSES OF ROADS

ITEM OF COST	APPROXIMATE RELATIVE COST OF OPERATION IN CENTS PER MILE ON THREE TYPES OF SURFACES		
	High type	Intermediate type	Low type
Gasoline	1.09	1.31	1.61
Oil	0.22	0.22	0.22
Tires and tubes	0.29	0.64	0.84
Maintenance	1.43	1.72	2.11
Depreciation	1.26	1.39	1.57
License	0.14	0.14	0.14
Garage at $4 per month	0.44	0.44	0.44
Interest at 6 per cent	0.36	0.36	0.36
Insurance	0.21	0.21	0.21
Total cost	5.44	6.43	7.50
Relative cost	1.00	1.18	1.38

From a recent examination of the data being developed at the Iowa Engineering Experiment Station, I have reached the conclusion that for economic studies it is on the conservative side to assume that the change from a lower type saves the automobile user about one eighth of the operating cost on that type. This amounts to 0.8 cent per mile of travel for the "composite average" automobile, on the basis of 1931 operating costs. For other classes of vehicles, particularly trucks, it is necessary to take into consideration the actual composition of the traffic. The data at hand are too fragmentary to permit the drawing of any very positive conclusions as to the saving to commercial vehicles effected by changing the type of the road surface.

It is believed that no serious error will result if economic comparisons are based on the average operation cost of commercial vehicles, assumed as 22 cents per vehicle mile of travel, and on a saving in cost by a change from an intermediate-type surface to a high type of 5 cents per vehicle mile of travel. Commercial vehicles of less than one-ton capacity should be counted as automobiles.

In allowing for decreased operation costs, when a relocation shortens the distance between objectives, account must be taken of the fact that such shortening does not affect fixed charges. A study of Table I would indicate that, for distance, the cost is about $2^1/_2$ cents per mile on high-type surfaces and 3 cents per mile on intermediate types, if it is assumed that one third of the depreciation is due to obsolescence and two thirds to mechanical deterioration. For commercial vehicles, the shortening of distance also decreases the time of travel between objectives. It is believed that a reasonable allowance for the shortening of a route would be 8 cents per mile for a high-type surface and 13 cents per mile for an intermediate type.

GRADE REDUCTIONS COMPLICATED

I doubt if there is any more elusive problem in the field of highway economics than that of estimating the potential saving that will result from grade reductions. This problem is complicated because the operating characteristics of the vehicles comprising highway traffic are so variable that there is no such thing as a single economic grade. The engineer is forced to compromise on grades that are feasible from the point of view of topographical conditions. The following steps constitute a rational approach to this problem:

1. Determine the total rise and total length (as shown by the survey stationing) of the grade to be reduced.
2. Determine the corresponding two factors for the proposed grade improvement.
3. Assume 4 per cent as a safe coasting grade for the vehicles that use the road, and determine the amount of rise in the proposed plan in excess of that which would be provided by a 4 per cent grade of the same length.
4. Estimate the annual tonnage of the traffic using the road. A conversion factor can be applied to the estimated volume of traffic to convert it into tonnage. For most projects it is safe to assume that the traffic is equally divided between the two directions.

Suppose that a gallon of gasoline weighs 5.9 lb., that each pound tests 19,000 B.t.u., that 1 B.t.u. is equivalent to 777 ft-lb., and that the average thermal efficiency of the automotive engine is 15 per cent. Then the various relationships involved may be expressed, for computation purposes, in the form of an equation, in which,

H = height in feet of existing summit above the sag
H_1 = height in feet of proposed summit above the sag
H_2 = height in feet of the summit of a 4 per cent grade of a length equal to the proposed grade, as measured by the survey stationing
M = low-gear factor for the existing grade
C = cost of gasoline in decimals of a dollar per gallon
R = annual saving by reducing the grade
T = annual tonnage of traffic over the highway.

The equation will then be:

$$R = 2{,}000\,\frac{[\frac{1}{2}T\,(MH - H_1) \div \frac{1}{2}T\,(H_1 - H_2)]\,C}{19{,}000 \times 777 \times 0.15 \times 5.9} =$$
$$0.00075\,[(MH - H_1) \div (H_1 - H_2)] \ldots [5]$$

If the grade reduction is accomplished by increasing the length of the road, then the saving computed by Equation 5 must be reduced by the cost of the extra distance.

A word with reference to the factor M. If an existing grade were such that a vehicle could ascend in low gear, there would be no economic reason to change it unless the change resulted in a saving in transportation cost. As a matter of fact, such a saving does result because of the decreased time required for the ascent, and the decreased cost of vehicle operation. Therefore the factor M represents the ratio of the cost of ascending an existing grade, with the gear that would have to be used, to the cost of making the ascent if it could be made in high gear, with high-gear speed and high-gear operating efficiency.

From these samples of the analyses involved in highway economics, some insight may be gained into the problems confronting state officials today. More and more it is becoming necessary to justify all expenditures by a rigid demonstration of their economy. It is hoped that this paper may contribute in some measure to the proper attack on the solution of these important problems.

Joint Trunk Sewers for the Hackensack District in New Jersey

By GEORGE W. FULLER
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
CONSULTING ENGINEER, NEW YORK, N.Y.

THE lower 16 miles of the Hackensack River in New Jersey is tidal; the valley has but little fall; and the river is highly polluted with sewage from the 58 New Jersey municipalities located on the watershed and their half million population. Present individual municipal disposal plants are nearly all inadequate and would have to be enlarged and extended to meet the requirements of the New Jersey legislature for more complete treatment. To undertake the watershed problem as a whole, the Hackensack Valley Sewerage Commission was formed early in 1931. At the meeting of the Sanitary Engineering Division on October 6, 1932, at Atlantic City, Mr. Fuller, one of the commission's engineers, presented the commission's plan to establish trunk sewerage systems serving that part of the valley in New Jersey. Because of flat slopes, two treatment plants were found necessary, one for the upper valley and one for the lower. While the activated sludge process is proposed for both these plants, a study is being made of the adaptability of the use of chemicals at the lower plant. The financial plan provides that the cost of construction is to be provided by the counties, which will then be reimbursed by the municipalities on a rental or tax basis, the charge to be pro-rated according to the amount of flow that each contributes to the system.

PARALLEL with the Hudson River and immediately west of the Palisades lies the Hackensack Valley, extending from Newark Bay into New York State and comprising a total area of about 209 square miles. In the lower 93 square miles below the New Milford Dam of the Hackensack Water Company the river is tidal, and the valley includes about 35 square miles of meadow land. The upland section comprises about 53 square miles in the State of New Jersey and about 62 square miles in the State of New York.

The present population of the valley is about 500,000, of which 450,000 live below the New Milford Dam, for the most part in Hudson County on the west slope of the Palisades. This population is located almost entirely in New Jersey, in 58 different municipalities, among them Bayonne, which was not named specifically in the act creating the Hackensack Valley Sewerage District. The reservoir formed by the New Milford Dam, used as a source of water supply by the Hackensack Water Company, has not yet become dangerously contaminated, considering the purification facilities of the Hackensack Water Company. However, it is expected that Bergen County will grow rapidly during the next few years as a result of the opening of the George Washington Bridge, and it is highly important to provide means for controlling pollution of the upland watershed both in New Jersey and in New York.

EXISTING PLANTS INADEQUATE

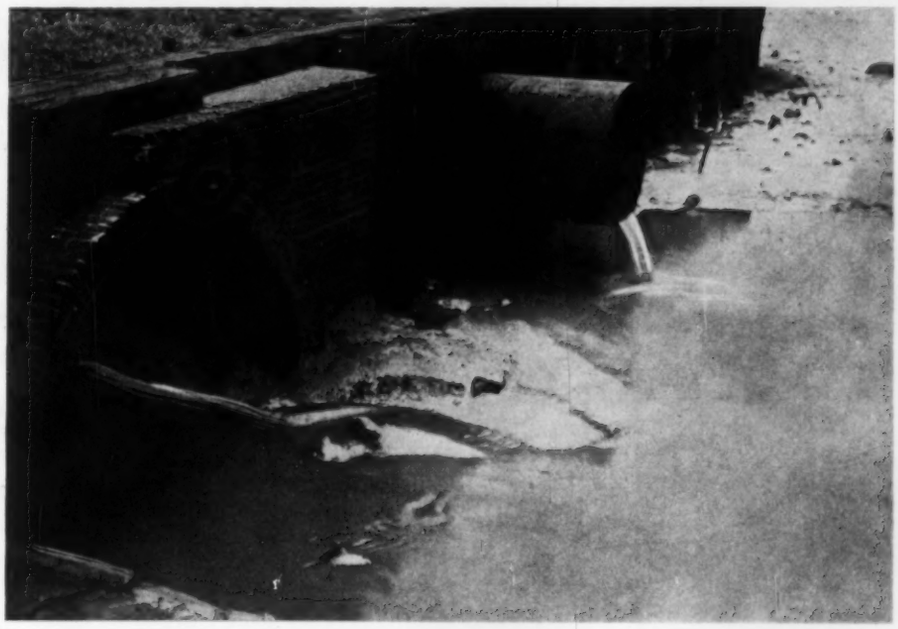
There are about 40 municipal sewage treatment plants in the Hackensack Valley, located for the most part below New Milford (at the head of tidewater) and north of a line drawn across the valley from the center of North Bergen to North Arlington.

South of this line there are isolated treatment plants for county institutions in Hudson County, on the Secaucus Ridge Road, and also a fine-screen plant at Kearny Point. There are no sewage treatment plants on the west slope of the Palisades south of North Bergen nor are there any on the westerly slope of the Hackensack Valley drainage area west of the meadows and south of North Arlington.

The great majority of the existing plants are either overtaxed as to capacity or have facilities that are inadequate to provide suitable reduction or elimination of the offensive conditions in the main river and its branches in the tidal section below the City of Hackensack, as shown by examination and analyses made by Richard C. Smith, chemist and bacteriologist.

SERIOUS POLLUTION EXISTS

Pollution in the tidal section of the Hackensack River and its branches is such as to interfere with the recreational use of the stream for bathing and boating. Below



TYPICAL SEWER DISCHARGING CRUDE SEWAGE INTO THE HACKENSACK RIVER

the City of Hackensack sewage solids have been discharged into the river and its branches for many years, with the result that foul decomposing banks of sewage mud move backward and forward under the influence of wind and tide and the natural flow of the stream during wet weather. During dry and warm weather the dissolved oxygen is reduced to amounts conspicuously below those now considered necessary for the protection of the health and welfare of the public. Until these conditions are remedied, the development of parks and bathing beaches, such as are becoming more and more prevalent in this section, will be seriously retarded.

REMEDIAL LEGISLATION PASSED

In 1926 an act of the New Jersey legislature was passed prohibiting the discharge of sewage and polluting matter into the Hackensack River at any point above the mouth of Bellmans Creek after May 1, 1930, unless the sewage was subjected to a minimum purification process including sedimentation and intermittent sand filtration. It was this act that led to the creation in 1930 of the Hackensack Valley Sewerage District and the setting up of a Sewerage Commission chosen by the Boards of Freeholders of the Counties of Hudson and Bergen. This commission was instructed to report its recommendations as to the most feasible plans or methods for the relief and prevention of the pollution of this river and its tributaries; and pending the submission of this report the enforcement of the Act of 1926 was postponed until May 1, 1931.

The Hackensack Valley Sewerage Commission was organized in January 1931. It conducted many public hearings and chose S. Wood McClave and George W. Fuller, Members Am. Soc. C.E., as its engineers. In December 1931, it completed its report, which was submitted to the legislature early in 1932. Since the funds for the preliminary work were furnished by the counties of Hudson and Bergen, the report of the Hackensack Commission was submitted to the freeholders of these counties for transmission to the legislature.

DISTRICT PLANTS PREFERABLE TO INDIVIDUAL PLANTS

After investigating conditions in the field, the commission's engineers recommended that a joint trunk sewerage system with two district treatment plants be constructed rather than that attempts be made to enlarge and improve the 40 municipal sewage treatment plants already in existence. They also recommended the construction of such additional plants as might be needed to take care of the sewage in Hudson County on the west slope of the Palisades, the pollution from which is now carried by tide to the upper reaches of the tidal section of the river. Two district plants were found cheaper per unit of capacity than the development of the individual plants. The latter would also be at a disadvantage in securing suitably isolated sites without long and expensive individual outfall sewers to reach them. Obviously, the operating cost per unit volume of sewage treated would be less for two large district plants than for a number of small ones. Difficulties in the financing of needed improvements by the individual municipalities were also a factor in some cases.

From the head of tidewater, which is at the New Milford Dam, to Newark Bay the distance by air line is about 16 miles. There is little or no slope to the ground, which for the most part is meadow land near or adjacent to the river. A single district plant for pumping and purifying the sewage would involve needless pumping

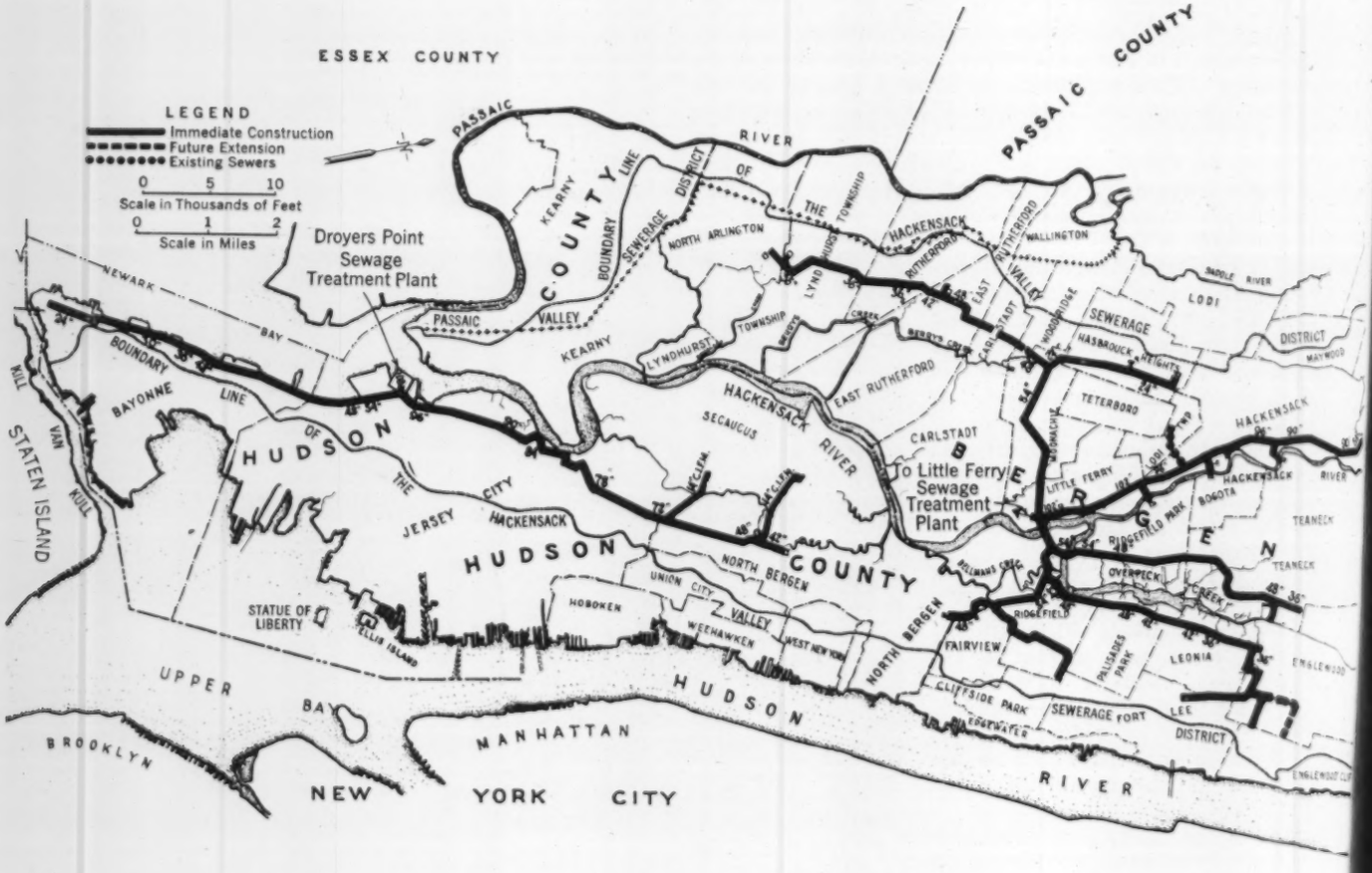


FIG. 1. PROPOSED TRUNK SEWER SYSTEMS FOR THE HACKENSACK

costs as well as expensive construction in places on account of soft foundations. It was decided to estimate costs on two systems of trunk sewers, each carrying sewage from the north and south to a separate treatment site. The entire length of the district sewers, or joint trunk lines and branches to serve the needs of the valley until 1947 was estimated at 60 miles, and at 84 miles to serve until 1960.

Two treatment sites were selected, the northerly one in the general vicinity of Little Ferry, near the northern limits of the Hackensack meadows, and the southerly one at Droyers Point, a short distance north of the boundary between Jersey City and Bayonne. All sewage can be conveniently discharged at these two sites except in a few isolated cases where individual plants can treat the sewage or industrial waste more advantageously for a time than can be done by delivering it to the trunk sewer systems.

TRUNK SEWERS PROJECTED

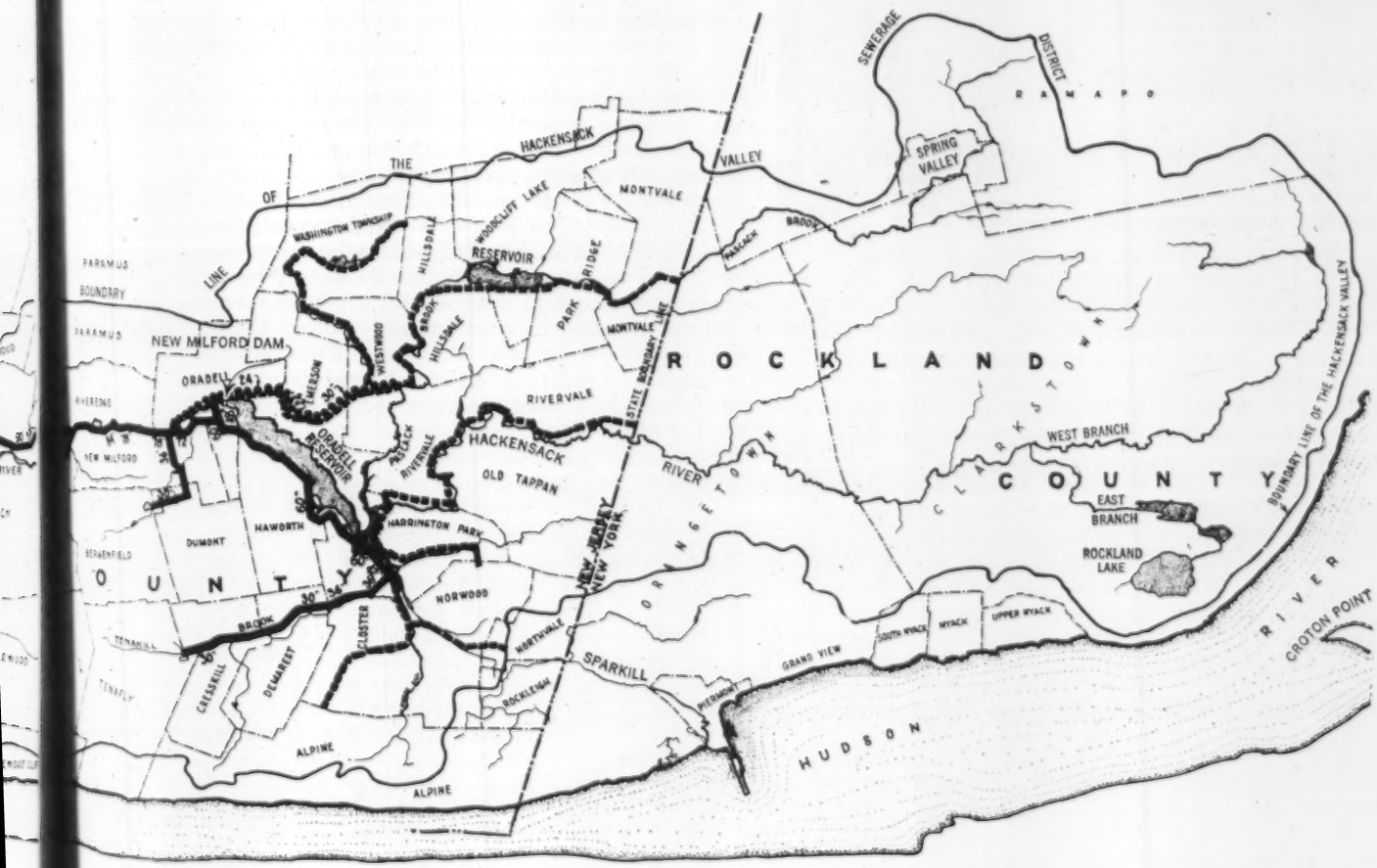
As initially built, the northern trunk sewer system will provide trunk lines extending to within three or four miles of the New York State line and south to below the junction of the main river and Overpeck Creek. Similar lines will extend to the treatment site from the south, east, and west. The trunk sewers will range in diameter from 30 to 102 in.; they will provide for the probable population in the upper valley 30 years hence, when the average sewage flow is estimated to be 115 gal. per capita daily, and the maximum rate of flow, following heavy rains, 293 gal. per capita daily. The sewers in the northern district are for the most part on a separate system, but soil conditions are such that infiltration will be relatively high during the winter and early spring.

The trunk sewers leading to the southern site near Droyers Point, Jersey City, range in diameter from 24 to 108 in. The sewers in this area, which is largely built up, are mostly in a combined system. To provide for the future population, their capacity was rated on the basis of 120 and 310 gal. per capita daily for average and maximum flows, respectively.

FLOW IN COMBINED AND IN SANITARY SEWERS

As has been shown, the maximum rate of flow assumed as coming from combined sewerage systems was taken as only slightly greater than that coming from separate systems, or respectively, 310 and 293 gal. per capita daily. The combined sewers were assumed to contribute, as a maximum, 2.6 times the average rate of the dry weather flow, or somewhat more than 1.5 times the average flow during the first flushing of storm water. For sanitary sewers, the maximum rate was taken as more than twice the assumed average domestic rate, about twice the assumed average industrial rate, and more than three times the assumed average rate of ground and surface water infiltration and leakage. However, different rates of infiltration and leakage were assumed for different parts of the district.

The question as to what is a suitable rate to assume for maximum infiltration and leakage is one meriting careful study and research. Opinions will differ as to whether the 129 gal. per capita daily allowed for the Hackensack sewers is too great or not. Experience shows that however carefully sewers are designed and constructed, infiltration and leakage reach large amounts, which increase with the age of the structure; and that it is the part of prudence to design separate systems with ample capacity if they are to serve their purpose as suitably as combined



RIVER DRAINAGE AREA IN NEW YORK AND NEW JERSEY

ones may be relied upon to do. It should also be borne in mind that, since the northerly trunk sewers deal with the flow of separate sewers, it is important from the health standpoint to prevent overflow into sources of potable water supply and stretches of river near water parks and bathing beaches.

SEWAGE RUNNING IN A GUTTER TO A TRIBUTARY OF THE HACKENSACK RIVER

As the basis for making estimates of the cost of treatment works, the activated sludge process was used by the commission's engineers. For initial construction, the works were estimated to have capacities to meet conditions until about 1947, when they would be enlarged to meet the needs of the following 15-year period. For the most part, the sewage would flow by gravity to pumping stations near the two treatment sites. The first installation would provide, at the northerly plant, for an estimated population of 392,000, with an average flow of 45 m.g.d.; and at the southerly plant, for a population of 285,000 and 34 m.g.d. The recommended treatment plants would consist of coarse screens, detritors, preliminary clarifiers, aeration tanks, re-aeration tanks, and final clarifiers.

In round numbers, the preliminary and final clarifiers would provide detention periods of about 1 and $2\frac{1}{2}$ hours, respectively, and the detention period in the aeration tanks would be 5.6 hours, including allowance for 25 per cent return sludge. The re-aeration period for the return sludge would be 4 hours. Cost estimates for sludge treatment were made on the basis of separate sludge digestion, the tanks to be heated by gas collected in the process, and the digested sludge to be dried on drying beds. For the northerly plant, the capacity of the digesters was estimated on the basis of 3 cu. ft. per capita, plus a capacity for sludge storage, to be used during cold weather, of 2.1 cu. ft. per capita, and a drying-bed area of 0.6 sq. ft. per capita. For the southerly plant, where there would be relatively more sewage solids received from the combined sewers, these capacities were increased by one third. Cost estimates were based on 1929 unit prices in order to give a suitable yardstick for measurement at a time when prices were abnormally low and fluctuating rapidly.

On this basis, the construction cost, including land and right-of-way, engineering, and contingencies, but not interest during construction, was estimated at $20,000,000 for that part of the work which will serve the needs of the district until about 1947. With extensions estimated to cost about $4,400,000, the facilities thus provided will serve until 1960 or later.

ALTERNATIVE ARRANGEMENTS

In seeking a solution to the problem of sludge disposal, consideration was given to vacuum filters for dewatering the sludge and to incinerators for burning it, either with or without the admixture of garbage and refuse from neighboring municipalities. Consideration was also given to methods of partial treatment intermediate between plain sedimentation, which was considered inadequate in a locality where all the upland flow is impounded above New Milford for months at a time, and complete treatment by the activated sludge process. Particularly for the southerly plant, to be located not far from Newark Bay, it was thought that it would be well, before active design was begun, to investigate the use of chemicals as a part of the program, as is now being done in a treatment plant at Dearborn, Mich., which was under construction when the Hackensack report was being prepared.

In the report of the Hackensack District Sewerage Commission were included recommendations for the establishment of a permanent commission to have charge of the installation and operation of the proposed joint trunk sewers, treatment works, pumping stations, and all appurtenances. It recommended that the funds for construction be provided on a stipulated ratio by Bergen and Hudson counties and that after the works were put in operation each contributing municipality should meet its share of the capital charges and expenses for operation and maintenance on a million gallon basis, the flow from each municipality into the trunk sewer system to be measured. It was further recommended that the several municipalities should have the option of joining the district project or not, and also of deciding whether the funds for payment by each should be obtained by sewer rentals, by tax budget, or by a combination of the two.

The proposed legislation for carrying out the recommendation of the commission was not enacted by the legislature of 1932, but the commission was continued, with instructions to arrange with the county officials to bring about, if practicable, a program for establishing an acceptable form of contract between the Hackensack Sewerage District Commission and the several interested municipalities. In the meantime the date for making effective the installation of sand filters, in accordance with the 1926 law, was moved forward another year, or until May 1, 1933. The personnel of the District Commission comprises Thomas J. Wasser, Assoc. M. Am. Soc. C.E., Supervising Engineer and County Clerk of Hudson County, Chairman; Horace R. Bogle, Vice-Chairman; Thomas F. Bowe, M. Am. Soc. C.E.; Gustav Meyer; and William R. Smith, Secretary.

Highway Traffic Control

Proper Regulation Serves the Ends of Utility as Well as Safety

AS engineers have been largely responsible for the astounding improvements in American pavements and highways, they are also greatly concerned with some of the more elusive problems connected with this expansion. One of its important phases, thought by no means the only one, has to do with traffic control. Too often the engineer has been satisfied to furnish the physical means providing all these vast facilities without considering how they will be handled or what personnel is at hand for their proper administration. Frequently it is possible to build safety and convenience into an improvement—to make it "foolproof" in principle. But more often a further step in education or administration is essential. In these two companion papers, Messrs. Bauer and Marsh explain just what the engineer's duties and opportunities are in this broad field. Both were originally presented before the Highway Division at its meeting in Atlantic City on October 7, 1932; Mr. Bauer's is given substantially complete, but Mr. Marsh's has been considerably concentrated to bring it within the available space. The decidedly practical approach of both these authorities will be greatly appreciated by all interested engineers.

Building Safety Into the Rural Road

By J. L. BAUER

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

STATE HIGHWAY ENGINEER, STATE HIGHWAY COMMISSION, TRENTON, N.J.

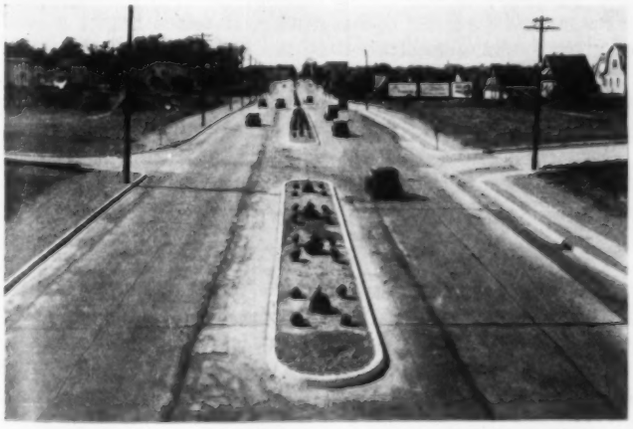
THE general subject of traffic control is based almost entirely on considerations of traffic safety. The aim of the modern highway builder is to provide a roadway that will be convenient, safe, economical, and scenic.

Traffic control would apply to the feature of safety. It is accomplished by hand-operated, period-operated, or traffic-operated signals and also by details of plan and construction. This paper will deal primarily with those features for controlling traffic that are incorporated in the highway itself. In view of the staggering loss of life and vast number of injuries that take place on American highways, the provision of such features seems to be the clear duty of the highway engineer. The formula enunciated by the American Road Builders' Association, "Safe vehicles plus safe roads plus safe drivers equal highway safety," should always be kept in mind by the engineer as far as it applies to "safe roads."

FEATURES OF THE GENERAL HIGHWAY PLAN

A new highway is frequently planned as a relief route to one already existing. In such cases the practice in New Jersey is to by-pass centers of population. To the town, this has the advantage of relieving traffic congestion in the business section and probably lessening accidents; to the motorist, it means a quicker and safer trip.

Wherever possible, rights-of-way should be 100 or 120 ft. in width and utilized for building divided roadways. In this construction provision should be made for a central space from 20 to 30 ft. wide, which is parked and planted. On roads where the volume of traffic is heavy, provision should be made on each side for 28 ft. of pavement, which will provide for two moving lanes and one parked lane, and space for a sidewalk in addition. This construction can be carried out on the rights-of-way as narrow as 80 ft., but that is about the minimum. The advantages of this type of roadway are many: elimination of danger of head-on collisions; elimination of headlight glare; provision of a central neutral space at intersections, where a motorist can wait until the opposing traffic has passed; much safer crossings for pedestrians; and confining of traffic to its proper lane on curves and steep grades. In open country this type of construction also lends itself to savings in grading opera-



TYPICAL NEW JERSEY DIVIDED ROADWAY
For Right-of-Way Widths from 80 to 120 Ft.

TRAFFIC CIRCLE NEAR TRENTON, N.J.
Many Such Circles Have Been Constructed in New Jersey

tions, as the roadways may be at different levels for long stretches. Eventually, when communities are built up along the highway and the necessity arises for a full-width pavement, the central parked space could be paved without the necessity of procuring additional right-of-way.

OVERPASSES AND UNDERPASSES AT THE NEW JERSEY APPROACH TO THE GEORGE WASHINGTON BRIDGE
In the Right Foreground, a Three-Level Highway Grade Separation

In New Jersey the cost of widening rights-of-way is very large, and for this reason it is sometimes less expensive to build another highway on a new alignment than to rebuild and widen the old one. Even if construction of the new highway costs more, it frequently is better, as in the end there are two roads where there was only one before. In planning our highways we give much attention to the procuring of right-of-way widths up to 100 or 120 ft. wherever possible.

In New Jersey the standard practice is to make bridges not less than 40 ft. in width, although many are built wider. Curves not exceeding 6 deg. and grades not exceeding 6 per cent are standard, but naturally cannot always be obtained.

TREATMENT OF ROAD INTERSECTIONS

Some years ago it was considered an excellent idea to obtain rights-of-way at all four corners of main intersections on state highways for "sight view" purposes. This would prevent building on the corners, and presumably the open intersection would tend to prevent accidents. However, this theory has been found somewhat fallacious. What actually happens seems to be that each motorist approaching the intersection considers that the other driver sees him and will slow down, which does not always happen.

At one such open intersection on the new Jersey City-Trenton highway, where the country was open for possibly a thousand feet in every direction, there were 31 accidents during the first month, two of which were fatal. The situation became so bad that the State Highway Commission had to insert traffic lights. It has now abandoned the idea of procuring land for "sight view" purposes. However, where it already had the land, the Commission has constructed traffic circles and this practice will be amplified in the future.

Before the days of the automobile, most bad accidents occurred at railroad grade crossings. Nowadays it is the rule rather than the exception for a highway to be planned with separations of grade at such crossings. On all New Jersey state highways, up to a few years ago, the railroad companies were compelled to share the cost equally with the state. Some two years ago, a law went into effect providing that in cases of new highway alignments, where separations were in question, it was unjust to ask the railroads to contribute. Until a few years ago there was little difficulty in getting the railroad companies to carry on railroad grade-crossing elimination work, but at present, with lessened business, it is much more difficult to procure their financial cooperation for this purpose.

A turning circle at a highway intersection is not at all new. In a great many cities, notably Washington, D.C., such circles have been used for years, before the existence of traffic problems. The traffic circle as now constructed is to my mind very efficacious for traffic control and highway safety. Such circles are usually laid out on a diameter of from 175 to 400 ft. The larger ones will admit six or even more road entrances and exits. The greatest advantage of the circle from the standpoint of traffic control is that the motorist proceeding at 50 or 60 miles an hour must slow down to 20 miles or so, thus gaining full control of his car. When a new circle is constructed on an old highway, it takes traffic a few months to get accustomed to it. It is a foregone conclusion that some motorist will run into the circle and become mired in the middle. Experience has shown that for the lighting of a traffic circle ordinary lights of between 400 and 600 candle power are generally preferable to floodlights, although in New Jersey there are good examples of both.

CARRYING THE HIGHWAY AROUND OR OVER

Underpasses and overpasses are frequently constructed on main roads for purposes of safety, and generally connections are provided between the two intersecting routes. Such connections are not always necessary, however, as frequently there are connections nearby that will answer the purpose.

In order to handle traffic more expeditiously and safely, New Jersey has constructed a number of viaducts and

depressed roadways. On the new highway from Jersey City to Trenton there is now being completed, on a three-mile stretch between Jersey City and Newark, a viaduct that overpasses two rivers with fixed-span bridges at an elevation of 135 ft. above tidewater. This construction will shortly be placed in service. Combined with that previously provided, it will obviate grade crossings between the Holland Tunnel in Jersey City and Elizabeth, a distance of about 13 miles.

Although the three-lane highway is now in quite general use, it has called forth opposition both from engineers and from the public. The claim is made that it is unsafe because the central lane may be used by motorists going in either direction. It is claimed that where the traffic is too great for two lanes, four lanes should be provided. In my opinion the three-lane highway has a definite sphere of usefulness, especially on roads containing long sections where travel is free and unobstructed and on those leading to resorts, where the greater part of the traffic is in one direction in the morning and in the other at night. A highway traffic-capacity survey made by A. N. Johnson, M. Am. Soc. C.E., in 1930 and 1931, disclosed that the practical capacity of a two-lane highway is 1,000 vehicles per hour; that of a three-lane highway is twice as much, or 2,000; and that of a four-lane highway is 3,000. On a number of three-lane highways in New Jersey, police have been successful in controlling traffic by allowing two full lanes for one direction and but one for the other direction.

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TWO-LEVEL HIGHWAY APPROACH TO THE HOLLAND TUNNEL BETWEEN JERSEY CITY AND NEW YORK

One of the Most Expensive Sections of Highway Construction in the World. Ramp in Foreground Leads from the Three-Mile Viaduct Between Jersey City and Newark, Shown in Cover Picture

Opinions differ as to the value of white lines 6 in. wide to mark traffic lanes. All seem to agree that on curves and at the tops of grades, where the sight distance is restricted, these lines dividing traffic are excellent. In New Jersey we go much further, marking entire lengths of four-, three-, and at times, two-lane roads. For four lanes we make the central white line 12 in. wide, and the other two each 6 in. Massachusetts, however, has stopped the painting of white lines, except at curves and at the tops of grades, it being claimed that traffic is better accommodated thus.

A QUESTION OF SIGNS

As regards route numbers, there is a great divergence of opinion. In many cases the main through routes carry the same number throughout their length in a particular state and in some instances through several states. Of course the Federal Highway Route numbering system frequently extends through many states. In New Jersey, route numbers are prescribed by the legislature, a practice which I think is a mistake. The result is that, on some of the through routes, from three to five different numberings are encountered. With the Federal route number added, the result is somewhat confusing. A better system, in my opinion, would be to leave the numbering to the State Highway Commission.

In New Jersey the standard direction sign is now of cast iron, not more than 3 ft. wide. The letters are black on a white ground. The Highway Commission has made some tests of visibility on different types of coloring, both by daylight and at night and also has taken photographs under varying conditions at various localities. The tests covered the present form and also white letters on black and orange letters on black. Opinions differed as to legibility, but the majority were in favor of the present system of black on white.

We receive complaints that the signs in New Jersey are not as clear and practical as those in some other states. I believe this is largely because the closely built-up areas require a great many signs and a large number of names on each sign, and also because two or more routes are frequently available. A sign cannot always direct the motorist to a particular route, as there may be several routes of equal value.

As to precautionary signs, such as those for curves and grades, it seems that for most of them symbols should be used rather than words or a combination of words and symbols. This practice is in vogue in Maryland, and other states are considering its adoption.

The use of reflector buttons has been very greatly extended in the past few years. The fact that the reflection is limited to a small angle has been a handicap, but improvements are now being made and this objection will no doubt be largely eliminated in the future.

A sign apparently liked by everyone is that sometimes used in New Jersey at circles and other intersections.

This sign, generally 2 by 4 ft., is electrically illuminated, from the interior, and carries black letters on a white ground. It is frequently double-faced, and is very clearly visible both in the daytime and at night. However, the cost of installation and operation is a considerable item.

SAFETY CONSIDERATIONS NECESSARY

Many examples are now in existence of highway planning and construction according to the most modern ideas. One such is being built by the State of Massachusetts from Boston to Worcester, some 25 miles. The right-of-way is 95 or more feet wide and includes an old road and a former street railway right-of-way. It is a divided highway with a central curbed space about 5 ft. in width and concrete roads on each side. At all main intersections there are underpasses, overpasses, and clover-leaf constructions. In Michigan also there are excellent examples of the divided roadway. Originally they were planned to include high-speed electric lines in the center. These have not been built as yet, and the strip is now parked and landscaped.

In general, state highway departments have no police force and no police powers and deal with traffic control only through construction and maintenance. Remembering that in 1931 over 33,000 persons were killed and over 1,000,000 injured in this country, state engineers must, as a basic consideration, develop all possible construction and other facilities that will tend to control traffic properly and safely. This principle is recognized by all, and engineers are tending to higher and higher standards in perfecting the necessary details.

City Traffic Needs Engineering Attack

By BURTON W. MARSH
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
TRAFFIC ENGINEER, DEPARTMENT OF PUBLIC SAFETY, CITY OF PHILADELPHIA

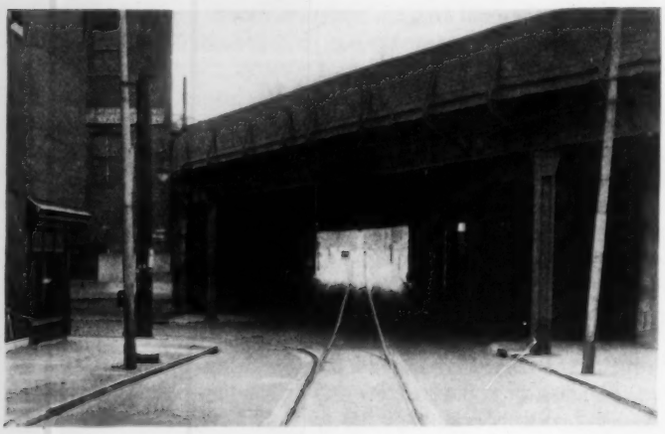
STREETS constitute the most valuable property under the direction of a municipality. Yet of the millions spent for their construction, much is still being wasted because of insufficient or untrained consideration of modern traffic needs. For example, how many streets can one recall whose widths have been determined without proper consideration of requirements for parking, for adequate moving lanes, for safety zones, and for pedestrian isles of refuge? How many multiple-entrance intersections have been created in the last ten years with little thought as to the hazards and traffic-control problems created?

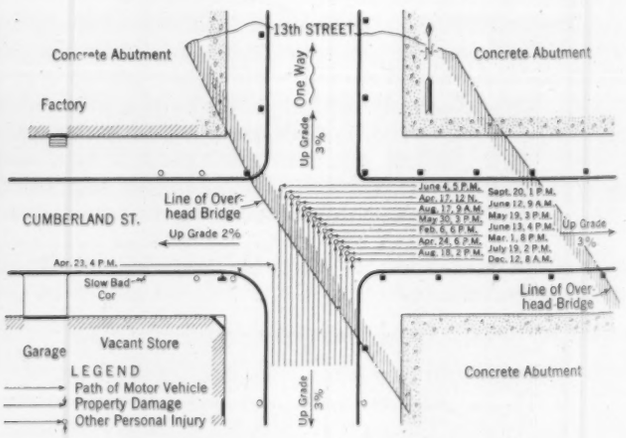
By intelligent design, the engineer can materially reduce traffic hazards and control problems. An essential and hitherto much neglected basis for such design is a thorough understanding of traffic operation. Therefore, even if the engineer has no interest in the problems of traffic control for their own sake, he must secure a thorough knowledge of them if he is to perform effectively his function as designer. But are there not good reasons why the engineer should be interested in problems of traffic operation for their own sake? It will be of interest to consider the problems involved in the use of city streets and judge to what degree they are engineering in character.

MAGNITUDE OF THE TRAFFIC CONTROL PROBLEM

As a background, it should be realized that for the 18 months ending December 31, 1931, America's traffic casualties were far worse than those suffered by the American Expeditionary Force in its 18 months of participation in the World War! Furthermore, the "traffic tax" for the average American family is from $100 to $150 per year, a toll that surely warrants attention in these days of expense reduction.

Is the traffic situation being given the attention that





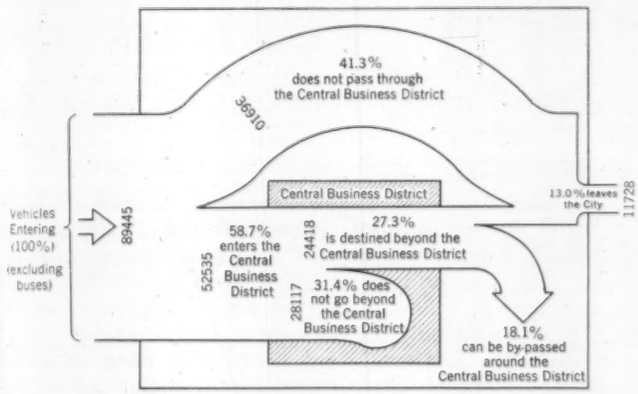
COLLISION FACTS—A BAD CORNER AT 13TH AND CUMBERLAND STREETS, PHILADELPHIA, AND ITS COLLISION DIAGRAM, COVERING A THREE-YEAR RECORD

Practically All Accidents Occasioned Injuries. Note That the Hazard Is Practically Confined to Two Directions and to Daylight Hours. A Flashing or a Luminous-Button Type of Stop Sign Is Evidently Required for Westbound Traffic on Cumberland Street, Which Has the Lighter Traffic Flow

its seriousness warrants? The answer is emphatically no! There is a curious anomaly between the condition and what is being done about it. If such a condition existed in private industry, competent management would give but one response: "This colossal waste and inefficiency must cease—at once." And the necessary steps would be taken for immediate correction.

UNWARRANTED APATHY TOWARD TRAFFIC IMPROVEMENT

Unfortunately it is hard to get the stockholders and management of the average municipal corporation to see the situation as it is, and many of those who do see it falsely believe that little more can be done about it. All too generally, even among engineers, an apathetic or discouraged attitude prevails. Some of the reasons for this are the relative newness of the problem, ignorance of its true seriousness, the generally indirect nature of its economic burden, lack of knowledge as to effective correctives, doubt as to the possibility of getting remedial measures adopted, and lack of strong leadership continuously pressing for constructive action. It is true that the problem is complicated and that much remains to be learned as to the best methods of solving it. Nevertheless, much is known about what should be done—far more than is being done in and for any city.



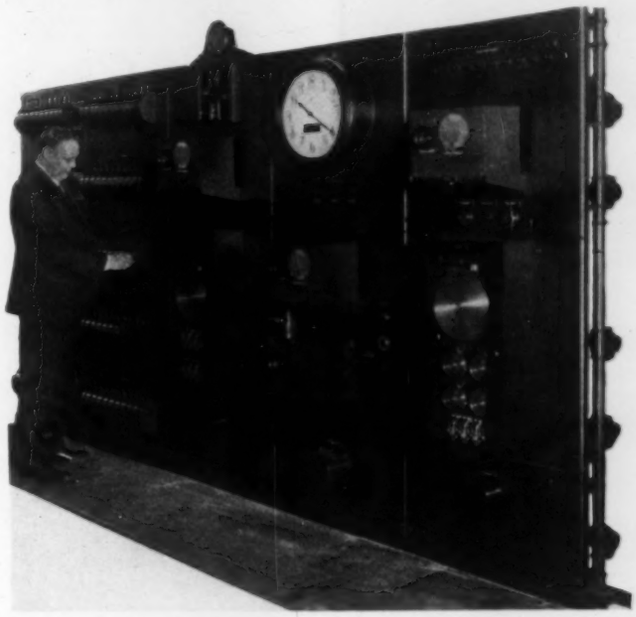
DISTRIBUTION OF TRAFFIC ENTERING PHILADELPHIA JUNE 6, 1929
Evidently a Considerable Proportion of Non-Productive Through Traffic Could Be By-Passed to Advantage

The attack on the traffic problem must be on a wide-flung front in the fields of legislation, administration, engineering, enforcement, and education. In all these fields, engineers are eminently fitted to serve their communities effectively, and in some, engineering direction is essential.

TRAFFIC LEGISLATION A JOINT RESPONSIBILITY

In handling their traffic problems, most American cities are governed by numerous traffic-control laws enacted by the state. Much state legislation is extremely inadequate, as for example in the examination and licensing of drivers, in the supervision of truck and bus operation, in requirements as to adequate safety-maintenance of vehicles, and in effective placing of financial responsibility. In the development of sorely needed improvements in state legislation, there is call for less guesswork and more fact-finding, impartial analyses—more of that scientific approach in which the engineer has been trained.

The municipal traffic ordinance is a very important supplement to the state traffic code. Local legislation such as parking regulations, and rules regarding "stop" and one-way streets and turn eliminations, should be based on thorough factual study and analysis—not on unstudied petitions and complaints! It is important to determine what matters should be governed by specific legislation and what by executive decisions, in the making of which there is opportunity to adequately safeguard the public. For example, a few cities set forth by ordinance where each traffic signal is to be placed, and just



MASTER CONTROL BOARD FOR A COORDINATED SIGNAL SYSTEM
This Mechanism Governing the North Broad Street District in Philadelphia, Is of the Modern, Flexible, Progressive Type

where loading zones for trucks shall be located. Are better results secured in this way than would be obtained if these matters were the responsibility of the proper executive?

Since traffic knows no political boundaries, the traffic ordinance should be basically in accord with existing national standards. A business-like plan for handling enforcement should be set forth in the ordinance. Engineering studies should be a major basis for the determination of municipal traffic regulations.

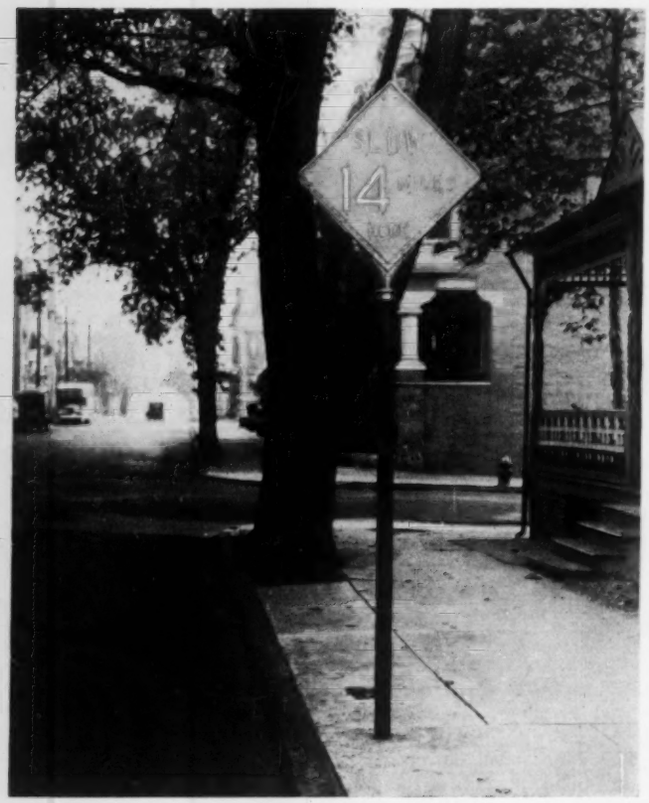
ADMINISTRATION REQUIRES REORGANIZATION

In most cities, the administrative organization for handling the traffic problem is antiquated, inadequate, and badly in need of reorganization. It was largely developed when traffic was a minor problem, and has failed to keep pace with its phenomenal growth. Competent business management, confronted with a new problem entailing heavy economic losses, would not hesitate to take corrective steps, even though these steps required drastic reorganization. Why, then, should municipalities hesitate courageously and aggressively to determine upon and institute the reorganization required to bring under control this new and serious traffic situation?

On the police chief generally rests the responsibility for handling traffic, although he is already overburdened with the problems of growing crime and is usually hampered by insufficient personnel. It is not surprising that he is ordinarily unable to give to traffic the attention which it deserves. Moreover, as is now being realized, traffic control to a large extent is a complicated engineering problem. Failing to take into account the changed aspect and increased complications of the traffic situation, many a municipal administration is still say-

ing, "The police have always handled the traffic problem; they should be able to continue to do so."

Various municipal agencies must cooperate if the traffic problem is to be effectively dealt with. City planners and engineers must design, and engineers must build, streets and intersections that will meet modern traffic needs. Street lighting programs must take into account traffic volumes and requirements. Engineers must secure, keep up to date, and interpret the necessary facts for a sound traffic improvement program. Standards for signs, signals, and markings must be developed. Police must handle the problems of enforcement with greater effectiveness. Traffic court organization and procedure must be modernized, legislative bodies must assist by enacting sound laws, and the city attorney must aid in effectively prosecuting important cases.



SAFE SPEED INDICATOR SIGN IN PHILADELPHIA
These Signs Are the Result of Extensive Engineering Studies Covering All Local Variables

However, everybody's job is nobody's responsibility. There is need, therefore, for centralization of responsibility as well as for coordination. The best simple method of securing both objectives is by the creation of a traffic commission made up of the principal city officials involved and, since the public is vitally affected, of a generous proportion of interested citizen-leaders—who will often prove the main driving force. To be effective, the commission must have a competent, permanent staff, which can best be provided by a traffic engineer employed by the city, together with the necessary assistants.

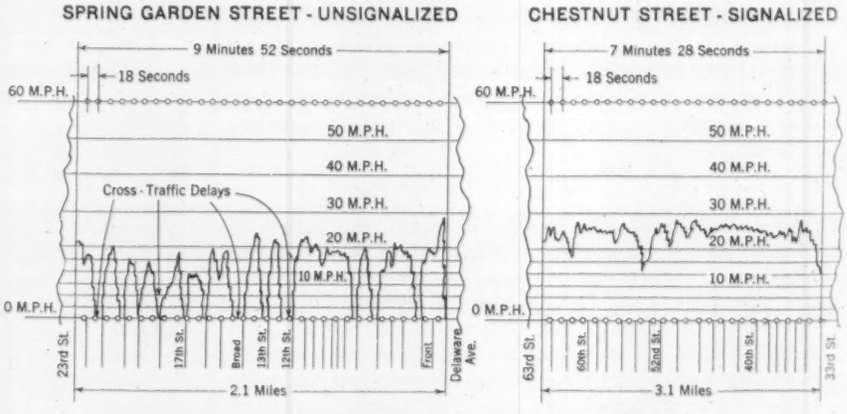
Since engineers are cognizant of the magnitude of the traffic problem, they can serve their communities well by recommending and urging the needed reorganization.

Traffic engineering is a necessity in every city if traffic problems are to be handled efficiently. At least 18 cities with a total population of more than 12,000,000 now have traffic engineers, and traffic engineering is being continuously carried on in at least 6 other cities. It is significant, considering the present economic stress, that at least 3 cities have appointed city traffic engineers during 1932. At least 17 other municipalities, recognizing the need for a factual approach, have had traffic surveys conducted by consultants to furnish the basis for sound handling of traffic.

The duties of a traffic engineer cover a wide field, including: (1) securing traffic facts and keeping them up to date; (2) organizing and analyzing information as to traffic accidents and devising remedial measures; (3) devising sound parking regulations on the basis of thorough study and analysis; (4) directing traffic signal work, including the design of signal systems; (5) controlling the placing of traffic signs and markings; (6) analyzing the traffic administration and developing improvements in it; (7) cooperating in the improvement of traffic laws, both state and local; (8) cooperating in devising physical, "traffic-effective" improvements in streets and intersections; (9) assisting the police in securing better traffic enforcement; (10) handling traffic complaints and requests; and (11) assisting in the work of traffic education. Several typical examples of traffic engineering work are presented in the accompanying illustrations.

ENFORCEMENT GENERALLY UNSATISFACTORY

The observance and the enforcement of traffic laws constitute one of the most important and at the same time one of the weakest links in the traffic-improvement chain! The percentages of convictions to arrests in a few cities are as follows: 9.7 per cent, 12 per cent, and 9.2. In one city, only 0.2 per cent of the persons tagged for ordinance violations were heard and fined or imprisoned, and nearly 70 per cent of those charged with violation of the state vehicle code were discharged. Unfortunately, in many cities a goodly percentage of drivers break traffic laws with impunity. Is it not inevitable that absence of proper discipline for violations leads to greater carelessness and recklessness, and hence to increased accidents—to say nothing of resulting inefficiency in the use of the streets and increased congestion?



EFFECT OF PROPERLY TIMED SIGNALS IN PHILADELPHIA
Records of Two Runs Show That Coordination of Signals Makes for Smooth Going

Records from cities that have improved their traffic-

enforcement systems indicate that deaths and injuries can be reduced at least one-third where modern, impartial, business-like handling of the enforcement problem replaces rampant "fixing." This is true because, in the great majority of cases, accidents involve one or more violations.

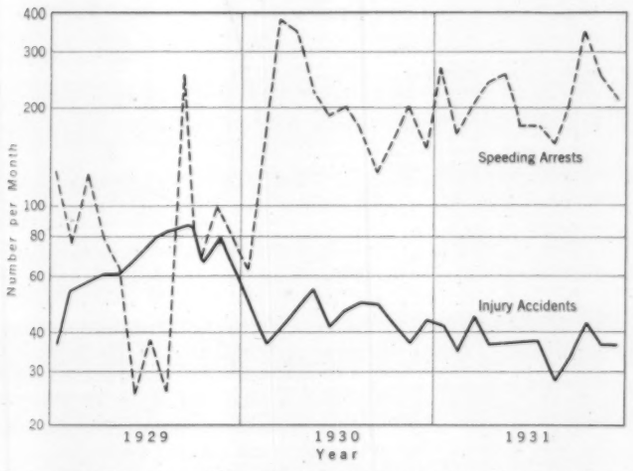
There are several remedies for the generally bad observance-enforcement situation. Enforcement facts that present a true picture of conditions must be gathered and kept up to date. Who is better fitted to secure and impartially interpret such facts than the engineer? Such facts should be kept before the city fathers and the public. "Fixing" and other abuses cannot flourish when the searchlight of publicity is kept focused on them. The very serious results of bad observance-enforcement conditions must be made clear.

It is also important that the entire machinery and procedure of enforcement be studied, and that adequate correctives be devised. A number of valuable reports dealing with this subject are available. New methods are proving valuable. One of these involves the principle that instead of devoting too much attention to fining, more emphasis should be placed on education, compulsory training, effective admonition, and cooperation with state licensing authorities.

Perhaps the most productive corrective step of all is effective and persistent pressure for satisfactory observance-enforcement conditions. This should be a principal work of the traffic commission. Experience has demonstrated that the engineer can serve effectively in bringing about better traffic observance and enforcement, even though the field seems remote from engineering.

POSSIBILITIES OF TRAFFIC EDUCATION

The modern traffic situation has come upon us so rapidly that the adult generation today is unfamiliar with many of its phases. Some one has said that "half the job of 'licking' the traffic problem is by education." Although this may be somewhat overstated, it contains a large kernel of truth. Effective traffic education does yield results. Proof of this is found in the fact that, while adult traffic fatalities are increasing rapidly, those of children are showing virtually no increase. Education, combined with discipline, has produced almost unbelievable decreases in accidents in hundreds of progressive commercial fleets. Progress is being made in controlled groups, such as school children and commercial drivers. The major job now is to find effective ways of educating and training the drivers of private passenger automobiles.



RELATION BETWEEN TRAFFIC ENFORCEMENT AND ACCIDENTS IN WICHITA, KANS.

Monthly Records for Three Years Indicate a Close Correlation. The Traffic Engineer Should See That Attention Is Called to the Value of Proper Police Supervision

HEAVY TRAFFIC FROM A HIGH VANTAGE POINT

North Broad Street, Philadelphia, One of the Busiest Traffic Arteries in the World, Has Lane and Special Parking Lines for Expediting Movement

A number of cities, where effective traffic education of all persons has been in progress for some years, are showing good results. In Pittsburgh, where very good work has been carried out by the traffic commission, with generous funds provided by the city, education, coupled with other sound traffic improvements, is responsible for a reduction in fatalities so far this year of 31 per cent.

How best to carry out the work of educating the private driver and the pedestrian is a question to be answered by each municipality independently. I firmly believe that the municipality itself should engage in such educational work, even to the extent of making considerable appropriations for it. Within reasonable limits, such money, well spent, will yield as great, or even greater returns in accident reduction and traffic improvement than are being achieved through other public safety expenditures now being made.

Numerous agencies of a civic nature are at present doing traffic educational work or are willing to cooperate in a well conceived program. Such a program may well be devised and coordinated by the traffic commission or by the local safety council. The engineer, realizing the results that can be obtained, should be interested in fostering effective traffic education.

After considering the facts that have been outlined, every engineer must agree that to a large extent traffic control is an engineering problem. If this is admitted, the seriousness of the present situation will challenge him to serve his community in combating its traffic problems.

New Jersey Ground-Water Supply Abundant

Its Geological Occurrence Explained and Its Importance to the State Demonstrated

By HOWARD T. CRITCHLOW

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
DIVISION ENGINEER, NEW JERSEY WATER POLICY COMMISSION, TRENTON

AS the available surface waters have become more costly to develop because of distance from the point of use, both communities and industries in New Jersey are selecting wells for their water supply. According to Mr. Critchlow, nearly 30 per cent of the water consumed by the public in that state is taken from ground-water sources. In cooperation with the U.S. Geological Survey, the State of New Jersey is collecting well records and conducting investigations of the sources and safe yields of the various water-bearing formations of the state. This article has been prepared from the paper presented on October 7, 1932, before the Sanitary Engineering Division at the Atlantic City Meeting of the Society.

BETWEEN the Hudson and Delaware rivers on the Atlantic seaboard lies the State of New Jersey, one of the leading industrial states. It has a rapidly growing population, yet its surface-water resources are limited to comparatively small streams, except the Delaware, which is an interstate stream. The fall line cuts across the state a considerable distance from the coast, placing about 60 per cent of its area in the Coastal Plain. This area includes much fine agricultural land, on account of which New Jersey is known as the Garden State. The fertile soil and nearby markets make truck gardening and fruit growing very important businesses. At the outer edge of the Coastal Plain, nature has built up barrier beaches, which have been developed into summer resorts of nation-wide fame. These industrial, agricultural, and resort developments demand an unfailing water supply for their continued prosperity and growth. Therefore the ground-water resources of the state are of vital importance and of great value.

GEOLOGICAL INTERPRETATION OF OCCURRENCE

In any area the amount and availability of the ground water are determined largely by the rainfall and the geological structure of the region. Throughout the State of New Jersey the amount of rainfall is quite uniform over long periods, and averages about 45 in. per year. The character of the rocks and their structural relations vary in the four principal topographic divisions of the state; the Appalachian Valley, the Highlands, the Piedmont Plain, and the Coastal Plain. The first three of these are embraced in the Appalachian province, which is that part of the state north of a line beginning at the City of Trenton on the Delaware River, crossing the Raritan River just below the City of New Brunswick, and extending northeasterly to the Arthurkill, near Carteret. South of this line is the Coastal Plain. In Fig. 1 these divisions are shown in more detail.

In general, ground water is not as plentiful in the northern as in the southern part of the state. In the Appalachian Valley, comprising Kittatinny Mountain, Kittatinny Valley, and the valley of the Delaware River above the Delaware Water Gap, the principal rocks are not very porous and hence do not carry a large volume of ground water. The water that penetrates the bedrock does so chiefly along minute joint cracks. Many of these in the limestones have been enlarged by solution into channels and cavities, although large quantities of ground water are seldom found. Here and there fault fissures carry considerable water, but in general the structure of the rocks is such that large quantities are probably not available. At least the few wells drilled in this region have yielded only small amounts.

The prominent northeast-southwest valleys in the Highlands are underlain by bedrock formations similar to those in the Appalachian Valley, and hence the same ground-water conditions prevail. In the mountain ridges and higher plateau country the principal bedrock is gneiss or coarse granite. The several varieties of gneiss are even less porous than the other formations, and no definite water-bearing beds occur. This condition is offset, in part at least, by the fact that the gneiss is broken by numerous joint cracks and fault fissures, which admit considerable amounts of water. Hence borings made indiscriminately in the Highlands may be expected to yield about as high a percentage of satisfactory wells as those in the Appalachian zone.

The bedrock of the Piedmont Plain consists chiefly of the shales and sandstones of the Triassic system, some of which are no more porous than the rocks of the Appalachian zone, although others carry considerable amounts of water. No well defined water-bearing beds are known to exist, but the strata are broken by numerous minute joint cracks so that they carry more water than those of either the Appalachian Valley or the Highlands. Moreover, the rocks are softer and can be drilled more easily and cheaply than those in the more northerly districts. These statements do not apply, however, to the areas of igneous or trap rock in the Triassic formations. These rocks are exceedingly hard and tough, and a number of wells driven in them at great expense, and to depths of hundreds of feet, have failed to find an adequate supply of water.

Flowing wells of great volume have been obtained at a few places in the Piedmont belt, although usually not in the Triassic bedrock but in the glacial deposits that overlie parts of the region. This is particularly true of the Upper Passaic Valley, where beds of open gravel and sand covered by impervious layers of clay provide favorable conditions for the accumulation of large supplies of water under considerable pressure. Abundant water is also obtained in some places by pumping from wells in the sands and gravels of the stratified drift. Good examples of this type of well are found near Plainfield and Elizabeth. Some of the flowing wells are probably located on or near great faults.

The Coastal Plain, constituting more than three fifths of the area of the state, presents in many ways a striking contrast to the three divisions of the Appalachian province that have been described. With very slight exceptions, the strata have never been consolidated into firm rock but still consist of beds of loose sand and soft clay and marl, with only a gentle slope toward the coast—undoubtedly almost the exact position in which they were

originally deposited. From the point of view of ground waters, the most important difference of all consists in the fact that many of the sand and gravel beds in the Coastal Plain are so porous as to have a great capacity for storing water, and furthermore, are so interlaminated with impervious beds of clay and marl that vast quantities of water are held under such pressure as to furnish abundant artesian flow. In the Coastal Plain of New Jersey alone there are more than 1,000 wells drawing their supply from these beds, and the number is constantly increasing.

As shown in Fig. 2, the structure of the Coastal Plain consists of unconsolidated layers of sand, gravel, clay, and marl, all resting on a rock floor. This floor slopes gently to the southeast at the rate of about 70 ft. per mile from its outcrop approximately along the west side of the Delaware River below Trenton. The Cretaceous strata lie next to the rock floor with the Tertiary formations above, but not completely covering the Cretaceous to the rock outcrop, thus leaving the outcrop exposed. Hence deep wells near the coast may penetrate not only the Tertiary formation that covers all that region, but may reach far down into the underlying Cretaceous.

On the rock floor, the Cretaceous water-bearing beds lie in the following order: Raritan, Englishtown, Mount Laurel and Wenonah, and Red Bank, as shown in Fig. 2. The Raritan formation contains a number of water-bearing beds, but these are less regular and continuous than those of any other formation of the Coastal Plain. However, the most abundant yields are from wells in this formation. The Englishtown, also a sand layer, is 100 ft. thick in Monmouth County, where it is an important water horizon. To the southwest it gets thinner and disappears entirely in Gloucester County. On the other hand, the Mount Laurel and Wenonah sands, which are about 80 ft. thick in the southwest, where they are important water-bearing strata, become less important in the northeast, because of decrease in both thickness and permeability. The Red Bank stratum is an important water horizon in the northeast, where it is a sand bed 100 ft. thick, but it thins out to the southwest and disappears near the northern border of Burlington County.

In the Tertiary system, which covers considerably more than half the area of the Coastal Plain, the chief water horizons occur in the Kirkwood and Cohansey formations. The Kirkwood contains several beds of water-bearing sand and is an important source of supply at Atlantic City and southward along the beaches. The Cohansey, which lies above, rivals the Kirkwood as a source of water for the beach resorts and the mainland back of the salt marshes.

Of New Jersey's total area of 8,224 square miles, only 710 square miles, or 8.5 per cent, is water surface. The population in 1930 was 4,041,334, an increase of 28.0 per cent since 1920. This makes the average number of inhabitants per square mile of land area 537.8, as compared with 420.0 in 1920. New Jersey, therefore, is one of the most rapidly growing and densely populated states in the country, having been exceeded in rate of growth during the past decade only by California, Florida, and Michigan.

In 1930, the number of inhabitants receiving water from a public supply was 3,626,994, or 89.8 per cent of the population. The total consumption of water was 403.5 m.g.d., or 111 gal. daily per capita. This water was furnished by 226 systems, of which 34 obtained water from surface streams, 175 from ground water, and 17 from a combination of the two. Of the total consumption of water, 71 per cent was surface water and 29 per cent ground water.

The increase in the consumption of ground water has been very rapid, the proportion of the total consumption increasing from 9.5 per cent in 1894, to 25.7 per cent in 1905, and 29.9 per cent in 1931. The reason for this is undoubtedly the availability of ground water at low cost for small communities. There has been an increase

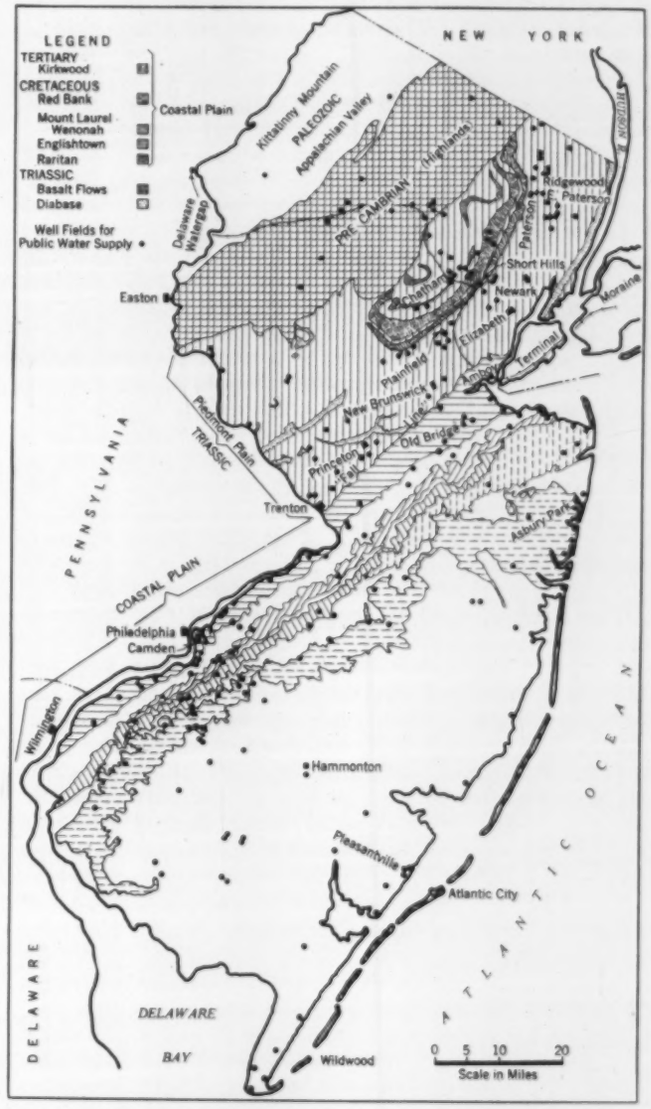


FIG. 1. NEW JERSEY WELL FIELDS SUPERIMPOSED ON A GEOLOGIC MAP TO SHOW PRINCIPAL WATER HORIZONS

in the number of systems using ground water from 83 in 1905, to 140 in 1918, and 181 in 1931. In some cases surface supplies have been abandoned on account of pollution and ground-water supplies substituted. This tendency to use ground water is also reflected in the large number of applications made to the State Water Policy Commission for the right to divert water for public use. Out of the 128 applications considered in the last five years, 119 have been from ground waters.

The rural population not served by public supplies depends almost entirely on ground water. In 1931 this population was 10.2 per cent of the total for the state, or 414,340 inhabitants. In addition many industrial and business establishments have private supplies taking water from wells. While no accurate data are available, it is estimated that the rural consumption from ground-water sources is about 16 m.g.d., and the private, industrial, and business use, about 50 m.g.d.

It is obvious that the ground-water resources of the state are of vital importance to the people of New Jersey. The Atlantic City region, which depends largely on ground water, is taken to include the section along the beach from Brigantine to Ocean City and on the mainland from Absecon to Somers Point. This area includes 11 separate municipalities having a permanent population of about 102,000. The water supply for the region is obtained from three sources: streams, shallow wells on the mainland, and deep wells on the beaches. The first two sources are used to supply Atlantic City and the mainland towns between Absecon and Somers Point. The deep wells are used for public supplies at Brigantine and from Ventnor southward to Wildwood, and for the private supply of many hotels and industrial plants in Atlantic City and Ocean City.

The average annual consumption from all sources in the entire region in 1931 was about 21 m.g.d. Of this amount 23.4 per cent was from surface sources, 37 per cent from shallow wells, and 39.6 per cent from deep wells. On account of the large summer population the maximum monthly consumption exceeds 30 m.g.d.

The deep sand, or so-called Atlantic City 800-ft. sand, is in the Kirkwood formation and was first used as a source of water in 1893. It is the most productive of the three sources at the present time and is the sole supply for all places along the coast between Brigantine and Stone Harbor, except Atlantic City, where an average of more than five million gallons daily is drawn from privately owned wells at hotels and industrial plants.

The shallow sand is tapped only on the mainland and lies within 250 ft. of the surface in the Cohansey formation. The Atlantic City Water Department formerly had 32 wells of small diameter in this formation and last year completed their replacement by 12 of large diameter with gravel walls, and having a capacity of 15 m.g.d. By increasing the draft from the shallow sand it is not necessary to draw so heavily on the surface water, which is highly colored cedar water, but otherwise a first quality water. The sources of water in the Atlantic City region are shown in Fig. 3.

The Camden region is taken to include a radius of ten miles from City Hall, Camden, having a population in New Jersey of about 290,000. Practically all this area obtains its public water supply from wells through 20 separate water systems. The average annual consumption for the region in 1931 was 29 m.g.d., of which 17.8 m.g.d., or 61 per cent, was supplied by the Camden Water Department. In addition to the public supplies, it is estimated that about 10 m.g.d. is obtained from private wells for industrial use, making a total consumption in this area of about 40 m.g.d. Since the part of Camden east of Cooper River is supplied by a private water company and uses about 2 m.g.d., the whole City of Camden uses 68 per cent of the public water supply output of the area. Most of the wells take water from the Raritan formation.

The City of Camden originally obtained its water supply from the Delaware River, which it continued to use until 1898. In that year a new supply was developed in the vicinity of Morris and Delair, about five miles northeast of Camden. This field covered about 95 acres on a narrow strip extending about 7,000 ft. along the Delaware River just below Pensauken Creek. There over 100 wells, mostly 8 in. in diameter, were used until 1926.

In 1922 four wells of large diameter, with gravel walls, were constructed within the city at strategic points, and from them water was pumped directly into the distribution system. Since that date four additional large wells have been built within the city; the wells of small diameter at Morris and Delair have been replaced by large ones; and a new field at Puchack Run has been developed. Today there are 17 large wells outside the city, having a total capacity of 32 m.g.d., in addition to the 8 city wells, which have a capacity of 11 m.g.d. All these are in the Raritan formation and are less than 190 ft. deep. They produce more water than any other group of wells in the state, and it is believed that they constitute the fifth largest public supply in the country. To date, the draft has not materially affected or depleted the supply, and it is estimated that considerably more water can be obtained from other wells in the area without undue interference with existing supplies.

In the Camden area, the water in certain wells has a high iron content. However, because of judicious selection of the wells pumped and frequent flushing of the distribution mains, the City of Camden has not found it necessary to install iron-removal equipment. In some plants excess iron is readily removed by aeration and filtration.

RUNYON AND ASBURY PARK DEEP WELLS HIGH IN IRON

The Runyon region, which includes the well field of the City of Perth Amboy, in the vicinity of Old Bridge, South Amboy, Sayreville, and South River, supplies a population of about 70,000. There two distinct water horizons are used, both of which belong to the Raritan formation. The shallow sand in the Perth Amboy well field is less than 100 ft. deep and is the principal source of supply for that city. In 1918, during the war-time activity, this well field produced about 12 m.g.d. The average annual consumption of the entire area in 1931 from public supplies was about 6.0 m.g.d. In addition to this, private wells in Sayreville, at Parlin, produced about 5 m.g.d.

The deep horizon, which is about 300 ft. below the surface, is used by the industrial supplies at Parlin, also in part for the public supply at South River, and by one well for Perth Amboy. This supply is high in iron and

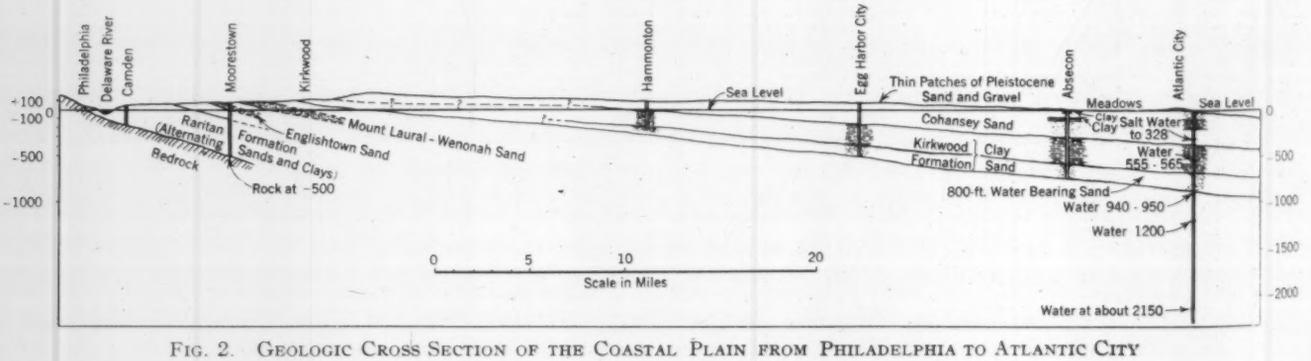


FIG. 2. GEOLOGIC CROSS SECTION OF THE COASTAL PLAIN FROM PHILADELPHIA TO ATLANTIC CITY

requires treatment to produce a satisfactory water for most uses.

The Asbury Park region, which includes the City of Asbury Park, Ocean Grove, Allenhurst, Avon, and Belmar, is supplied by ground water from three formations. The average annual consumption in 1931 was 2.7 m.g.d. and the permanent population was about 18,000. This area is a summer resort region of great importance and has a summer population and water demand of double the amounts given. It should be noted that these data do not include the western part of Asbury Park, Bradley Beach, and certain adjacent areas. These places are supplied from surface sources by the Monmouth Consolidated Water Company, which serves a large area to the north. In fact, since May 1932, Ocean Grove has been supplied from surface courses.

WELLS IN GLACIAL DEPOSITS AND ROCK

The Passaic River Valley area near Chatham is generally referred to as Canoe Brook, because the principal well fields tap glacial deposits in the vicinity of the confluence of Canoe Brook with the Passaic. This area is also in the bed of Glacial Lake Passaic, and the most important wells are believed to lie in drift-filled channels of the pre-glacial drainage system. The wells are about 160 ft. deep to the underlying rock floor. The systems which take water from this area, in order of maximum draft, are as follows: Commonwealth Water Company, City of East Orange, Madison, Chatham, and the Normandy Water Company—all of which together serve a population of about 210,000. The average annual consumption from wells in this area in 1931 was 10.3 m.g.d. In 1929 the consumption was 12.5 m.g.d., due in part to the fact that since that year the Commonwealth Water Company has developed a surface supply from Canoe Brook, which it uses to supplement its ground-water supply. This company furnishes water to Summit, Millington, Stirling, Livingston, West Orange, Millburn, New Providence, and Maplewood.

The territory supplied from this area is growing rapidly and the additional water that can be obtained from wells is limited.

Along the line of the outlet of the pre-glacial Passaic Valley are the well fields of the Short Hills Water Company and the Elizabethtown Water Company. It is the opinion of some geologists that these wells draw water from the drift-filled channel of the old drainage system. About 7 m.g.d. was obtained from these well fields in 1931.

In order from top to bottom, the water-bearing formations utilized in this area are Mount Laurel–Wenonah, Englishtown, and Raritan. The Mount Laurel-Wenonah lies between 420 and 500 ft. below the surface and is the least important of the three horizons being used at Ocean Grove and Avon. The Englishtown is generally about 600 ft. deep and is used by all places in the area except Avon. The Raritan is the most important and lies between 1,000 and 1,135 ft. below the surface. It is the principal supply for Asbury Park and constitutes a reserve supply for the Monmouth Consolidated Water Company at Whitesville Station. This company's main supply comes from Swimming River, near Red Bank. The Raritan Formation is high in iron, and water obtained from it in this locality is treated by aeration and filtration for removal of the excess.

A number of localities in New Jersey are supplied with water from wells in the shale and sandstone rocks of the Triassic formation. The more important of these are the City of Garfield, Ridgewood and vicinity, Hawthorne, South Orange, Plainfield, and Princeton. Also, some industrial plants in Paterson and Newark obtain important supplies from wells in rock. These rock wells are limited in yield by the storage capacity of the rock cracks and fissures. Wells located along faults or zones of shattered rock have better yields, and some of the wells in porous sandstone supply more than the average yield.

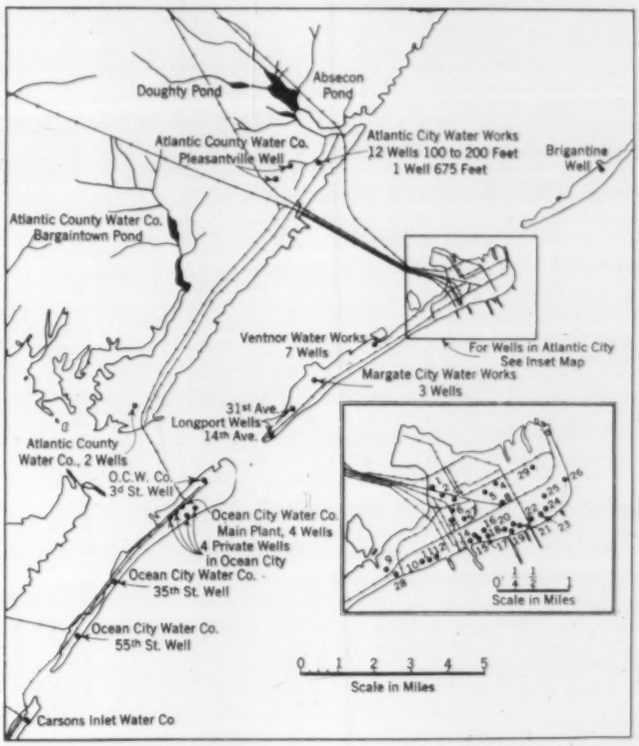

Doughty Pond
Absecon Pond
Atlantic County Water Co. Pleasantville Well
Atlantic City Water Works 12 Wells 100 to 200 Feet 1 Well 675 Feet
Brigantine Well
Atlantic County Water Co. Bargaintown Pond
Ventnor Water Works 7 Wells
For Wells in Atlantic City See Inset Map
Margate City Water Works 3 Wells
31st Ave. Longport Wells 14th Ave.
Atlantic County Water Co., 2 Wells
O.C.W. Co. 3d St. Well
Ocean City Water Co. Main Plant, 4 Wells 4 Private Wells in Ocean City
Ocean City Water Co. 35th St. Well
Ocean City Water Co. 55th St. Well
Scale in Miles
Carsons Inlet Water Co

FIG. 3. SOURCES OF WATER SUPPLY IN THE ATLANTIC CITY REGION

1	Atlantic City Electric Company	15	Marlborough-Blenheim Hotel
2	Pennsylvania Railroad	16	Brighton Hotel
3	Atlantic City Gas Company	17	Traymore Hotel
4	Supplee-Wills-Jones Dairy Company	18	Knickerbocker Hotel
		19	Chalfonte Hotel
5	Abbott Dairy Company	20	Haddon Hall
6	Reading Railroad	21	Strand Hotel
7	Atlantic City Brewing and Ice Company	22	Blackstone Hotel
		23	Saint Charles Hotel
8	Guarantee Trust Building	24	The Breakers Hotel
9	Atlantic City High School	25	Galen Hall
10	Chelsea Hotel	26	Royal Palace Hotel
11	Ambassador Hotel	27	American Ice Company
12	Ritz-Carlton Hotel	28	President Hotel
13	Shelbourne Hotel	29	Citizens Ice Company
14	Dennis Hotel		

STATE AND GOVERNMENT COOPERATION

Records of wells have been collected for many years by the State Geological Survey. These data form the basis of the early studies that were made for the development of ground-water supplies for many cities, towns, and private persons throughout the state. Since 1924, special investigations have been conducted by the state in cooperation with the U.S. Geological Survey. Representative localities have been under observation since that year, and a number of bulletins have been issued describing the work, summarizing the data, and giving general conclusions as to safe yield. Such bulletins are available for the areas at Atlantic City, Camden, Asbury Park, and the Passaic River Valley near Chatham. Other places where studies are now under way are Runyon, Garfield, Ridgewood, Short Hills, and Princeton. The work of the U.S. Geological Survey in New Jersey has been directed by David G. Thompson, senior geologist, and the writer has had charge of the investigation for the state.

HINTS THAT HELP

Today's Expedient—Tomorrow's Rule

The minutiae of everyday experience comprise a store of knowledge upon which we depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from young and old alike, should afford general pleasure not unmixed with profit.

Square Roots to the Fourth Significant Figure by Slide Rule

By WILBUR BLACK
KINCAID, KANS.

A FAST and simple method for obtaining the square root of a number to the fourth significant place by slide rule is here presented. This method is based on the formula:

$$(x^2 + y)^{1/2} = x + z$$

where $z = \frac{y}{2x + z}$. The values of x and y can be determined quickly, as x is the first integer in the square root of the number and y is the number minus x^2. The value of z is found in successive steps by slide rule, using $\frac{y}{2x}$ as the first trial value of z in the formula, $z = \frac{y}{2x + z}$. As a numerical example of this procedure, the steps in obtaining the square root of 7 to four significant places will be outlined.

The value of x is found to be 2, and y will be $7 - x^2$, or 3. The trial value of z will be $\frac{y}{2x}$, or 0.75. Then, substituting in the formula, $z = \frac{y}{2x + z}$, obtain $z = \frac{3}{4 + 0.75} = 0.632$. Substituting this value of z in the formula, obtain a new value equal to 0.646. Having found the value of z, the root, or $x + z$, equals $2 + 0.646$, or 2.646.

In some instances this method works equally well to the fifth place. For example, take the number 4.3. The y in this case is 0.3. By successive divisions the equation $\frac{0.3}{4.0736} = 0.0736$ is obtained, and the square root of 4.3 is 2.0736.

If the value of x is taken to two significant figures, the following three significant figures can be obtained on the slide rule by this process, and the square root computed to the fifth, and possibly the sixth, significant figure.

The suggestion has been made by H. E. Jordan, Associate Professor of Mathematics, University of Kanas, that, if the number whose square root is sought is slightly less than the square of an integer, the following formula could be used:

$$(x^2 - y)^{1/2} = x - z$$

where $z = \frac{y}{2x - z}$. For example, if it is desired to find the square root of 34, write the numeral in the form of $36 - 2$. Then $x = 6$ and $y = 2$. Solving for the value of z, as before, obtain $z = 0.169$. The root then equals $x - z$, or $6 - 0.169 = 5.831$.

Our Readers Say—

In Co ·ment on Papers, Society Affairs, and Related Professional Interests

Arch Ribs for Entire Dead Load

TO THE EDITOR: The article, "Deck Participation in Concrete Arch Bridges," by A. H. Finlay, in the November number, is worthy of study by all engineers engaged in the design of reinforced concrete arches. Similar studies have been made previously, as is noted in the foreword to the article, but the matter is of sufficient importance to merit its further consideration.

It seems to me that Professor Finlay has given too much weight to the subject of the relief of dead-load stresses by the participation of the deck. It is true, as he states, that, "The results are predicated on complete continuity of the structure before the arch centering is struck. In so far as this condition may be modified in practice, the results may be modified."

The centers for the arch ribs in large bridges are usually removed before the concrete of the superstructure is poured, in which case the dead-load stresses would be carried entirely by the ribs. In any case, the concrete of the arch ribs will be poured sometime before that of the superstructure, and will therefore be much stiffer when the centers are removed. They will consequently carry a greater proportion of the dead load than is indicated by the model analysis. For these reasons, it is proper to design the arch ribs for the entire dead load, with the possible exception of the weight of the street paving, which is usually put on after the structure is otherwise completed.

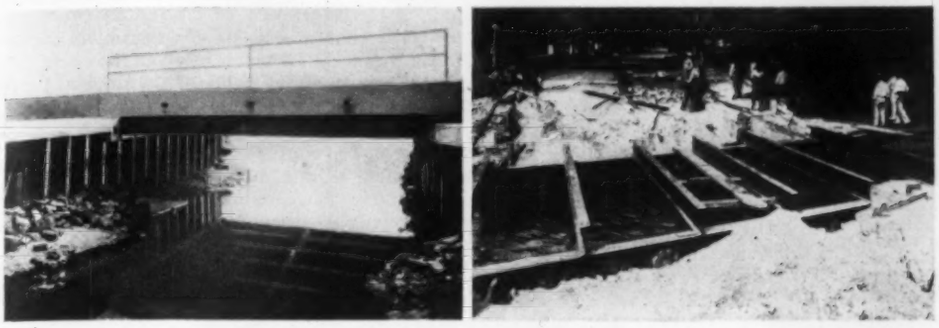
In this article the effect of the superstructure on the magnitude of the temperature stresses is well brought out, and too much emphasis cannot be placed on its importance. One feature, however, has been omitted. That is the localization of the bending stresses in the arch ribs, in the panels where expansion joints are present. This increase in the rib stresses of these panels is noted in the report of observations on the Gilbert Street Bridge at Danville, Ill., made by W. M. Wilson, M. Am. Soc. C.E., Research Professor of Structural Engineering at the University of Illinois, in articles in Bulletins No. 174 and 226 of the University of Illinois Engineering Experiment Station. These investigations show clearly that intermediate expansion joints are a source of weakness and are better omitted, especially in arches with low decks, in which the deck and rib are integ·l at the crown. The increase in the temperature moment at the springing line due to their omission is easily provided for.

CLYDE T. MORRIS, M. Am. Soc. C.E.
Professor of Structural Engineering
Ohio State University

Columbus, Ohio
November 8, 1932

Steel Sheet Piling in Bridge Construction

TO THE EDITOR: In connection with the article by Messrs. Mason and Ogle in the September issue of CIVIL ENGINEERING, I should like to make a few comments. The use of steel sheet piling for the abutments and wing walls of the Bay Street Bridge recently built by the city engineering department of Tampa, Fla., effected a saving in the cost of the bridge and the time required for its construction. Poor foundation conditions necessitated carrying the abutments down to rock, located at an average elevation of 14 ft. below mean low water.



BAY STREET BRIDGE, TAMPA, FLA.
Sheet Piling for Bridge Abutments Eliminates Cofferdams

As the city had no appropriation to cover emergency work, it was imperative that the bridge be built at the lowest possible cost. The steel sheet piling abutments reduced the cost of the bridge by eliminating expensive cofferdams and subaqueous construction. The two rows of steel sheet piling forming the abutments and wing walls were driven to rock and then cut to grade. The abutments were capped with two angles and a plate; the wing walls with concrete coping.

It is understood that steel sheet piling bridge abutments are quite numerous in Germany but, so far as I am aware, this form of construction has not been used in the United States. Photographs of the bridge are reproduced here. It was designed and built under the supervision of R. H. Cason, City Engineer, Tampa, Fla., and Hartness and Disbrow of the same city were the consulting engineers.

W. C. DISBROW, JR., Assoc. M. Am. Soc. C.E.
Hartness and Disbrow, Consulting Engineers
Tampa, Fla.
October 28, 1932

Point Resistance of Piles Analyzed

DEAR SIR: The description of rolled steel column sections used as piles in Nebraska bridge foundations by Messrs. Mason and Ogle, in the September issue, should cause a widespread use of this type of pile. The discussion of test values, however, is based on a wrong assumption and should be revised. The point resistance of a pile is not equal to the difference between the maximum jacking load and the lifting load.

The resistance of a pile to downward movement is equal to the sum of (1) its point resistance, (2) the product of a coefficient of surface friction and the summation of all active soil pressures acting on its surface, and (3) the wedging action induced in the adjacent soil because of the shearing of a hole and compression of the displaced material into the adjacent volume. The absolute as well as the relative values of these factors depend on the nature of the soil strata penetrated. The resistance due to the frictional component of active earth pressure cannot be very important in absolute value because of the large ratio of the depth of pile to its diameter or width. The soil face cut by the pile has a high ratio of depth to width. On such faces there can be no horizontal or vertical pressure even in soils of low internal resistance.

The wedging factor is important. Several authors have shown it diagrammatically as a "bulb of pressure," giving no scale or attempt at numerical values. The resistance of this factor is equal to that part of the bearing value of such bulb which can be transferred to the pile by skin friction. With known soil characteristics, it can be approximately evaluated by computing the load required to squeeze the displaced volume of soil into unlimited (for isolated pile condition) soil beds at various depths and multiplying the resulting resistance by the coefficient of skin friction. In non-uniform soils, the computation may be simplified without great loss of accuracy by omitting the less elastic soil layers.

The resistance of a soil to upward motion is the algebraic summation of the product of a coefficient of surface friction and the total of all passive soil resistances induced by the upward motion (a drag) and the upward push (in the nature of a buoyancy) caused by the release of the squeezing action. This summation has no relation to the summation of the second and third factors in the resistance to downward motion.

A true evaluation of point-bearing can be obtained only by testing a pile in its final position, releasing its point support, and then determining the new bearing value. This is probably most easily done by pulling a pile upward a distance of, say, 12 in. and, after a rest period of about 24 hours, reloading the pile to test its skin frictional value after some 6 in. of driving or jacking. It is hardly possible in any soils with the exception of flowing silt that the space under the pile will become filled, and in soils which would flow sufficiently to fill the void there is very little point bearing.

The easiest way to withdraw a pile is to first start a downward motion. The effect is to "lubricate" the surface by eliminating adhesion, thereby reducing the skin resistance coefficient and preparing the soil to give its help by buoyancy, or upward kick, as the pulling starts.

JACOB FELD, Assoc. M. Am. Soc. C.E
Consulting Engineer
New York, N.Y.
September 28, 1932

Steel-Pile Bridges in California

TO THE EDITOR: In connection with the subject of "Steel-Pile Foundations in Nebraska," so ably presented by Messrs. Mason and Ogle in the September issue, I should like to mention the experience of the Bridge Department of the Division of Highways, State of California, with this type of construction.

These piles were used in building four bridges. In Project No. 1, the Lytle Creek Bridge near San Bernardino, there are five 35-ft. steel-stringer spans on a 50-deg. skew, with one 5-ft. walk and 42-ft. roadway on steel-pile bents. There were 1,321 lin. ft. of new steel piles—10-in. H-piles weighing 49½ lb.—furnished at $1.65 per lin. ft.; and 1,600 lin. ft. of used 8-in. steel piles for bank protection of miscellaneous weights at $1 per lin. ft. The cost per pound for an f. o. b. job averaged 3½ cents. There was a total of 73 piles, averaging 50 ft. in length, and the cost of driving was $21 each.

Project No. 2 is an arc-welded steel viaduct near Merced. This structure, which is 1,380 ft. long, consists of 40-ft. steel beam spans and 20-ft. tower spans on steel piles. The deck is of concrete with a 24-ft. roadway. There were 6,200 ft. of 8-in. H-piles weighing 32 lb., furnished at $0.90 per lin. ft., or 2.80 cents per pound, while 230 ft. of 14-in. H-piles weighing 84 lb. were furnished at $2.58 per lin. ft., or approximately 3 cents per lb. The average length of the 136 steel piles was 47 ft., and the cost of driving was $18 each.

The Santa Clara River Bridge near Montalvo constitutes Project No. 3. This structure, which is 1,806 ft. long, consists of twenty-one 86-ft. plate-girder spans supporting a 42-ft. roadway and a

5-ft. walk. Concrete piers on steel piles form the substructure, and 19,100 ft. of 8-in. H-piles weighing 32 lb. were used, the cost being 2.98 cents per pound, or $0.955 per lin. ft. The cost of driving these 30-ft. piles was $11.90 each.

The last project in which steel piles were used was the Fresno River Bridge at Madera, which has eleven 41-ft. steel-stringer spans on steel-pile bents. The piles are incased in concrete jackets which present a more substantial appearance. The roadway is 32 ft. wide, and one 6-ft. walk is carried. This bridge required 3,220 ft. of 8-in. H-piles weighing 32 lb. and costing 2.81 cents per pound, or $0.90 per lin. ft. The bid price for driving each pile was $16.

A different type of hammer was used for each job. Driving conditions varied from coarse gravel and hard clay to sandy soil. There was a consistent load capacity for all these projects in which, using the *Engineering News* formula, the factor of safety was 2. It is a striking coincidence that our test set-ups and results are so nearly identical with those of the Nebraska State Highway Department although neither organization was aware of the operations of the other.

The use of jets was similar to the action obtained with concrete or timber piling. Less brooming of pile heads occurred if they were notched in the web to facilitate bending of the flanges toward the center. Badly damaged portions were burned off. Twisting of piles was overcome to some extent by the use of rolling hitches while driving.

As a result of these experiences, we make the following recommendations: (1) steel H-piles should preferably have a minimum dimension of 10 in. and a metal thickness of at least $^3/_8$ in.; (2) a steel driving head, with grooved recesses fitting the pile head and with guides to keep it in the leads, should be specified; (3) projections attached to a pile for the purpose of increasing its bearing capacity are a potential source of danger and should not be used; and (4) where considerable penetration must be obtained under difficult driving conditions, a heavy steel pile section is a solution.

A. J. MEEHAN, Assoc. M. Am. Soc. C.E.
Associate Bridge Engineer
Division of Highways, State of California

Sacramento, Calif.
September 23, 1932

Western Interest in Public Land Problems

TO THE EDITOR: In his paper in the September issue, Mr. Stabler has given in brief an interesting and informative story of the public domain. Nearly all of the land in the eastern part of the United States open to settlement under the homestead law was fertile and productive. The result was comfortable homes and fairly complete settlement, with the agricultural production always sufficient for the needs of the urban population and a surplus of agricultural products for export.

West of the one hundredth meridian, on the other hand, the vast majority of the land area is not suitable for tillage. After many years it was recognized that 160 acres of this poor land was insufficient for the support of a family, and enlarged homesteads of 320 and then 640 acres were made available. In the main the homestead law in the arid and mountainous West was used as a means of obtaining title to water holes, streams, and grazing land that could not be secured otherwise under existing law, and for the passing of title to our best forest lands through dummy entrymen to large corporations.

Much of the settlement involved not only waste of the time and money spent in clearing and improvement of the land, but also a scattering of land ownership into hundreds and thousands of small units, making it so much the more difficult to reassemble the land in large blocks for grazing or for irrigation development. It would seem that a program of classification and of disposal thereafter under plans adapted to the most economic use would have been far better for the West and for the nation than was the blind application of the homestead law to these great areas.

With the development of the idea of conservation, the West has come to be looked upon in a large measure as a storehouse of certain valuable commodities for future use by the nation. Among these are timber, minerals, and oil. No agency other than the Federal Government can successfully cope with feasible irrigation projects remaining, because of their great size, the interstate character of the streams involved, and the long time required for construction, settlement, and development.

Thus far Western reclamation has been financed chiefly from the sale of Western public lands. It is the one outstanding example of Government investment that is largely repaid, and yet the Federal reclamation program in recent years has been subjected to severe criticism, particularly by those in the corn and cotton belts, on the ground that the waiving of interest in connection with repayment of the reclamation costs constitutes an unwarranted subsidy to the irrigation farmer. In effect, however, it is simply a conversion of a part of the value of the original public domain in the West into projects of practical use toward providing the agricultural production essential to a well-balanced development of the states west of the continental divide.

Concerning the handling of mineral lands, this should be accomplished as now through the Interior Department until such time—if that time ever comes—when all lands are ceded to the states. I doubt the desirability of having one agency or group of officials to deal with grazing outside the forests, while grazing within the forests is handled by a different group. The stock grower on the whole would much prefer dealing with a single agency. As the Interior Department now handles such matters as surveys, land titles and disposal, and classification, it would seem to me logical to transfer the Forest Service from the Department of Agriculture to that of the Interior, leaving to the Department of Agriculture the broad field of problems more directly related to the best and most profitable utilization of the agricultural lands of the nation.

R. K. TIFFANY, M. Am. Soc. C.E.
Consulting Engineer

Olympia, Wash.
October 30, 1932

Data on Mansfield Merriman

DEAR SIR: I noticed an item concerning the late Mansfield Merriman, M. Am. Soc. C.E., on page 601 of the September issue of CIVIL ENGINEERING. In this article it was stated that Professor Merriman was Lehigh's first Professor of Civil Engineering.

This is not strictly correct. The first teacher of civil engineering at Lehigh was Prof. H. S. Goodwin, who bore the title of Demonstrator of Civil Engineering from 1868 to 1871. In 1871, Prof. Charles McMillan was appointed Professor of Civil and Mechanical Engineering. He served until 1875 when August J. DuBois succeeded him. The latter held the post until 1877. Professor Merriman held the title of Professor of Civil and Mechanical Engineering from 1878 to 1881 when the two departments were divided. Professor Merriman became head of the department of civil engineering in 1881 and served in that capacity until 1907.

A graduate of Lehigh University in 1874, I knew these men personally and feel that you may wish to make a correction of this item.

CASPAR WISTAR HAINES, M. Am. Soc. C.E.

Philadelphia, Pa.
November 3, 1932

Beam Deflection Equations in Error

TO THE EDITOR: I read with interest Mr. Burmister's article on "Deflection in Reinforced Concrete Beams" in the October issue. In checking the derivations I have noted some inconsistency in the results. Evidently, the value of C, as defined on pages 626 and 627, is only half as large as it should be; that is, the definition should read $C = \frac{2\,k_1}{k_2}$. The values of Table I are then correct.

Mr. Burmister implies that Maney's equation has been verified by the results of tests. It is true that measured deflections and deflections calculated by means of Maney's formula have agreed remarkably well when the calculations have been based upon measured values of e_s and e_c. However, for the purpose of predicting deflections it is convenient to write Maney's modification of his equation

$$\Delta = C \frac{L^2}{dE_s} (f_s + nf_c)$$

or the equivalent,

$$\Delta = C \frac{L^2}{d} \left(\frac{f_s}{E_s} + \frac{f_c}{E_c} \right),$$

where f_s and f_c are the calculated or nominal stresses in the steel and concrete, respectively. When this is done, it is usually found in beam tests with rapid loading that the measured deflections are considerably less than those calculated, unless the values of E_c are taken to be larger than those commonly used in design calculations of stresses.

The actual deflection tends to approach the predicted as the loads are increased. Under a long-time loading, time yield may cause the deflections to be larger than predicted. Hence, when n and E_c are used in deflection formulas they should be considered as empirical coefficients, and closer estimates of the deflections may be made if the values chosen vary with the magnitudes and duration of the loads. Although the same result could be achieved by applying a similar empirical correction to Mr. Burmister's Equation 3, published data on deflections of beams and on time yield in concrete are in a more convenient form for application in Maney's modified equation.

D. E. PARSONS, M. Am. Soc. C.E.
Civil Engineer
U.S. Bureau of Standards

Washington, D.C.
November 7, 1932

[*The author has verified the omission and appoves the correction in the value of C.*]

Concrete Beam Deflections—General Derivation

TO THE EDITOR: The article by Mr. Burmister in the October number brings up an important subject. The stiffness of a member subjected to a given moment is an inverse function of its rotational deflection. Hence, the determination of the deflections of reinforced concrete members is of the greatest importance. Although tests, as published in Technologic Paper No. 2 of the U.S. Bureau of Standards as early as 1911, show that the percentage of steel has a marked effect on the deflections, the preponderance of opinion appears to be in favor of computing the relative stiffness of such members as if they were homogenous and neglecting the effect of the reinforcement. Mr. Burmister is to be congratulated on attacking the subject along rational lines.

As a somewhat more general derivation of Mr. Burmister's Equation 3, consider an element dx of a reinforced concrete member subjected to bending. Let $d\theta$ be the angle subtended by the terminal radii. On the assumption that the tension in the concrete is negligible, the unit elongation of the tension steel is

$$e_s = (1 - k) \frac{d\theta\, d}{dx} \quad \ldots\ldots [1]$$

But

$$e_s = \frac{M}{E_s A_s jd} \quad \ldots\ldots [2]$$

Hence, letting Δ be the deflection of one point (x_1) on the axis of the member with respect to the tangent to the axis at a second point (x_2),

$$\theta = \frac{1}{E_s} \int_{x_1}^{x_2} \frac{M dx}{A_s(1 - k)jd^2} \quad \ldots\ldots [3]$$

and since $\Delta = \int x d\theta$,

$$\Delta = \frac{1}{E_s} \int_{x_1}^{x_2} \frac{M x dx}{A_s(1 - k)jd^2} \quad \ldots\ldots [4]$$

These expressions are identical with the well known moment-area equations, excepting that E and I have been replaced by E_s and $A_s(1 - k)jd^2$, respectively.

Since $M = A_s f_s jd$ (in which f_s is the stress at the section where M applies), Equation 4 may be written

$$\Delta = \frac{1}{E_s} \int_{x_1}^{x_2} \frac{f_s x dx}{(1 - k)d} \quad \ldots\ldots [5]$$

Equation 3 may be used to determine the rigidity of members in which A_s, kd, and jd vary along the axis. Equations 4 and 5 are seen to be more general forms of Mr. Burmister's Equation 3, in which f_s is the stress at the section of maximum moment and kd is taken as a constant.

In the formulas given, the concrete is assumed to take no tension, whereas in fact, it takes an indeterminate amount of such stress, dependent upon the magnitude of the loading and the extent of cracks produced by temperature stresses, change in volume incident to setting, etc. Also, the position of the neutral axis is a function of E_c, which varies considerably with the conditions under which the concrete is placed and cured, the materials used, their proportioning, and also with time.

It is therefore questionable if the deflection of concrete beams is susceptible to other than approximate mathematical determination. It should, however, be noted that E_c may vary between rather wide limits without having a marked effect on k and the deflection. Also, in the determination of the stresses in continuous beams and frames, it is the relative, rather than the absolute, rotational deflections which govern moment distribution and hence the stresses.

O. G. JULIAN, M. Am. Soc. C.E.
Jackson and Moreland
Consulting Engineers

Boston, Mass.
October 11, 1932

Keeping Road Costs Down

DEAR SIR: The article by Mr. Catton on "Single-Lane Improvement for Local Roads," in your August issue, is quite in line with a suggestion in a paper entitled "The Future Road—the Wearing Surface," which I presented to the first International Road Congress held in Paris in October 1908. I had been appointed by Governor Hughes to represent the State of New York.

The congress had been called by the French government to consider the problem of the destruction by the automobile of the fine macadam roads for which the country was noted. It was evident that either the surface of these roads would have to be protected in some way, or another form of construction adopted. My paper dwelt principally with the protection of existing macadam roads, and my reference to a single-track lane was as follows:

> To recapitulate, assuming that the drainage and foundation of a given macadam road—new or old—is satisfactory, and that only the macadam wearing surface, as at present constructed, deteriorates too rapidly, it is proposed to replace the customary wearing surface with, say, 2 in. of a bituminous wearing surface, . . . In order to reduce the cost, it may be advisable to cut down the width of this bituminous wearing surface on roadways of the lightest traffic to 6 ft., and on other roadways to 9 or 12 ft., depending upon the amount of traffic . . . . The sides of the strip could be finished with ordinary macadam, or such other surface as might be suitable. . . . It is evident that the method above outlined may be applied even to roads of light traffic. . . .

In view of the difficult financial situation that faces our state and Federal governments, Mr. Catton's article is timely and should receive careful consideration. The day of constructing highways more costly than the traffic warrants is over for the present.

PHILIP W. HENRY, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.
October 22, 1932

Restatement of Deflection Formula

TO THE EDITOR: I was interested in reading Mr. Burmister's article in the October 1932 issue, entitled "Deflection in Reinforced Concrete Beams," further described in the subtitle as "A Simplified Formula for a Modern Theory Verified by Tests."

The simplified Formula 3 in Mr. Burmister's article is a restatement of Formula 3 in the progress report by T. D. Mylrea, entitled "Deflection of Reinforced Concrete Members," published in *Proceedings* of the American Concrete Institute, for 1931, page 351. Formula 3 expresses the deflection in terms of the stresses, f_s and f_c (or f_s and k), whereas the original formula by Professor Maney (see page 627 of Mr. Burmister's article) expresses deflection in terms of deformations, e_s and e_c. The two deflection formulas are identical only when $e_s = \frac{f_s}{E_s}$ and $e_c = \frac{f_c}{E_c}$. But the latter equation does not hold for concrete members in building structures or for specimens kept under sustained load in testing laboratories. For such conditions, the unit shortening of the extreme concrete fiber, e_c, should rather be taken as the sum of the elastic term, $\frac{f_s}{E_s}$, and the inelastic term, e_i, or $e_c = \frac{f_c}{E_c + e_i}$.

In his progress report, Professor Mylrea says: "It is as yet an open question just to what extent the permanent deformation of the concrete affects the deflection, and this, of course, leads at once to the study of long-continued loads and plasticity." Some studies of this nature have been made by Professor Maney and are reported in *Engineering and Contracting* for June 1930 and April 1931. His tests and studies show that a considerable part of the deflection is due to inelastic deformations (such as shrinkage) in the concrete.

Formula 3 of Mr. Burmister neglects the contribution to the deflection from inelastic deformations and is therefore not as general or as valuable as the original formula from which it is derived. It would be interesting to know whether the tests at Columbia University, which are merely mentioned in the article, included studies of "long-continued loads and plasticity."

THOR GERMUNDSSON, Assoc. M. Am. Soc. C.E.

Urbana, Ill.
October 13, 1932

Soundings Accurately Plotted by Triangulation Intersection

DEAR SIR: An article of much interest to me was that by William D. Ayers in the September issue. His method has been used by the Federal Government for a number of years, and in fact has been employed in the actual vicinity of the location described in this article.

The U.S. Engineering Department, a branch of the War Department, maintains a number of field parties whose duties in surveying the channels and waterways about New York Harbor include the location of soundings by the triangulation method. Scattered throughout the district are a large number of coordinated control stations, and from these as many as four transitmen at one time have been stationed to "shoot flags" on the pontoons or launch doing the actual sounding. This not only furnishes a check on the accuracy of the intersections but also minimizes the chance that something will be in the line of sight at the instant a flag is raised to signal the transitmen. As a further check on error, alternate flags are of different color and the time is noted by each transitman at the time of the "shot." Obviously all flags at that time, as recorded by the different transitmen, must be of the same color.

Large detail sheets, covering the area being surveyed, were prepared on linen back vellum, with the necessary detail of dock and shore line drawn on, together with the triangulation stations, or sounding stations as they are more commonly called. In many cases, protractors, properly oriented, are drawn in ink on the detail sheet, as a means of saving time and ensuring accuracy. Strong black cotton thread served the purpose of laying off angles, black contrasting well against the white detail sheet.

As Mr. Ayers states, it is a fast, accurate, and most satisfactory way of locating soundings in hydrographic surveying.

W. F. SCHUYLER

Montclair, N.J.
October 18, 1932

Footings on Compressible Soils

DEAR SIR: While of elementary nature, the paper by Preston M. Geren on "Designing Footings by Charts," in the October issue of CIVIL ENGINEERING, is one that certainly should receive greater discussion by designing engineers. Many engineers and builders have seen buildings in which uneven settlement has developed, with the resulting change of stresses in the columns, girders, and connections, and the accompanying hideous cracks in walls, ceilings, and floors. Since this change does not take place until the application of a part of the live load, I feel that foundations on compressible soils should be designed for some settlement load, with the use of a unit soil pressure causing settlement, all in terms of the dead load plus the percentage of the live load on the lowest tier of columns. This percentage of live load may be largely a matter of judgment, but preliminary tests should determine closely the percentage to be used.

It would therefore appear rational, if uniform settlement is to be achieved, to make use of a design soil pressure, which shall be known as the unit load producing settlement. It is obvious that for conditions of maximum load this unit settling load would be the dead load plus some percentage of the live load coming on the lowest column, all divided by the area of the footing that has the greatest ratio of live load to dead load. Then no footing would have a unit soil pressure under full live and dead loads that would exceed the allowable bearing pressure of the soil.

For the past fifteen years, I have brought this subject to the attention of my classes. Fifteen years ago the prevailing practice was, as it still is in many places, to obtain the footing area by simply dividing the full live and dead loads by the maximum allowable unit soil pressure. During 1926, the New York City Building Code came out with the idea of proportioning all footings for dead loads only. I believe this method is severe and even prohibitive.

It is interesting to note by specific examples the sizes of the footings obtained in practice by the three different methods, and especially the large variation in size obtained by proportioning for dead load only, and for dead load plus, say, 25 per cent of the live load. In the first method use is made of full live and dead loads and full allowable unit soil pressure on all footings. The second method allows for dead load plus a percentage (say 25 per cent) of the live load, and the third method allows for dead load only. Assume the following live and dead loads, taken at random, on four different footings of the same building:

	(1)	(2)	(3)	(4)
Live load	300,000	100,000	200,000	300,000
Dead load	100,000	200,000	150,000	200,000
Total	400,000	300,000	350,000	500,000

Assume a maximum unit soil pressure of 8,000 lb. per sq. ft. The sizes, in square feet, of footings Nos. 1, 2, 3, and 4, would be, respectively, as follows:

	(1)	(2)	(3)	(4)
First method	50	37.5	43.75	62.5
Second method	50	64	57	78.6
Third method	50	100	75	100

By inspection of these values, it will be noted that footings designed by the second method represent approximately a mean between those designed by the first, or usual, method and those computed by the third method. Obviously, if there is likely to be any settlement of the foundations, it is highly desirable that it should be uniform throughout. I therefore feel that the unit soil pressure should be in terms of some unit load causing settlement.

GILBERT MORRISON, M. Am. Soc. C.E.
In Charge of Structual Design
Cooper Union Institute of Technology

Yonkers, N.Y.
November 7, 1932

SOCIETY AFFAIRS

Official and Semi-Official

New Members Shed Luster on Honorary List

TO THE ROSTER of eminent engineers comprising the Society's Honorary Membership, three important names are being added as a result of election by the Board of Direction last October. The standards of this particular grade of Society membership are largely maintained by the high type of men represented in it. To most minds, such membership signifies the highest honor that engineering has to offer, at least in this country. Because of this distinction, every effort is taken, and rightly so, to maintain the standards previously set.

Certainly the high regard in which this honor has always been held will suffer no diminution by the election of Lincoln Bush, John E. Greiner, and Charles L. Strobel. The Society delights to honor those whom it considers worthy, and the ceremony of conferring Honorary Membership on these three men will take place at the forthcoming Annual Meeting. As a preliminary to this, a brief biography of each recipient is submitted. Unfortunately, these sketches can refer only to the distinguished accomplishments of these men in the field of engineering. But their many friends will rejoice to think of those qualities of mind and character that they possess which make this latest distinction the more fitting.

Briefly, the outstanding professional accomplishments of these latest Honorary Members are as follows:

LINCOLN BUSH

BORN in Palos Township, Cook County, Illinois, on December 14, 1860, Lincoln Bush was graduated from the Cook County, Illinois, Normal School in 1881 with the degree of M.A., and from the University of Illinois in 1888, with the degree of B.S. In recognition of his attainments, his alma mater conferred on him the honorary degree of doctor of engineering in 1904. Mr. Bush began his professional life as a teacher, but soon entered upon the career of engineering. After holding various positions in the Middle West, he became Bridge Engineer for the Delaware, Lackawanna, and Western Railroad, later serving as Chief Engineer of the same road. During this period of nine years he directed a program of extensive betterments for the modernization of the Lackawanna Railroad. He is the inventor of the Bush train shed, now in extensive use both in this country and abroad.

Since 1909, most of his time has been devoted to consulting engineering and contracting, especially in the fields of railroads and bridges. He served during the World War as Associate Officer in charge of the Engineering Division of the Construction Division of the U.S. Army in charge of, and responsible for, the design and for the practical operation of the facilities installed at the seven terminal ports of Boston, Brooklyn, Port Newark, Philadelphia, Norfolk, Charleston, and New Orleans; and for the 14 interior warehouses built at industrial centers, three arsenals, and other miscellaneous projects with a combined total cost of $234,000,000.

He was successively commissioned Major, Lieutenant Colonel, and later Colonel in the Construction Division. According to one of the high officials on this work, Colonel Bush performed his duties with characteristic "energy, sound judgment, and a marked degree of technical ability. To the exercise of these qualities and the application of an unusual personality and uncommon engineering knowledge to the problems of the construction work of the Army, the success of the engineering features of that construction work is largely attributable."

During recent years, after retirement from more active practice, Colonel Bush has done considerable consulting work, specializing on railroad matters, grade elimination, valuations, and similar subjects.

He has served the Society in many important capacities—as Director from 1912 to 1914, Treasurer from 1915 to 1916, Vice-President from 1924 to 1925, and as President in 1928. He is also a member of the American Railway Engineering Association and of the Western Society of Engineers.

JOHN E. GREINER

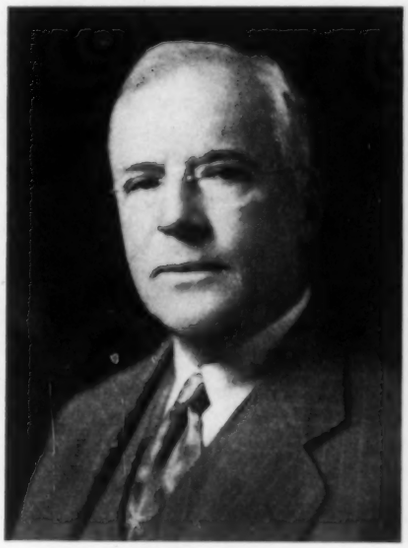
JOHN E. GREINER was born in Wilmington, Del., in 1859. In 1880 he received the degree of B.S. from Delaware College, in 1883 the degree of C.E., and in 1917 the degree of Sc.D. from the same institution.

Following engagements with the Edgemoor and the Keystone bridge works, he was employed from 1885 to 1891, and again from 1893 to 1908, by the Baltimore and Ohio Railroad in various capacities ranging from Chief Draftsman to Assistant Chief Engineer.

In 1908 he entered private practice, with offices in Baltimore. He has been retained on important bridge work by the Baltimore and Ohio and by many other Eastern and Middle Western Railroads.

Since entering private practice he has been retained as con-

CHARLES L. STROBEL
Consulting Engineer, Chicago, Ill.



JOHN E. GREINER
Consulting Engineer, Baltimore, Md.

LINCOLN BUSH
Consulting Engineer, East Orange, N.J.

HONORARY MEMBERS OF THE SOCIETY ELECTED IN 1932

sulting engineer on more than 300 important bridges and engineering structures in the cities of Baltimore, Md.; Johnstown, Pa.; Bridgeport and Norwalk, Conn.; St. Augustine, Fla.; Chattanooga, Tenn.; and elsewhere. He has served as chairman of the Committee on Iron and Steel Structures of the American Railway Engineering Association; member of the Society's Joint Committee on Concrete and Reinforced Concrete, 1903–1916, and of its Special Committee on Specifications for Bridge Design and Construction; member of the Committee on Bridge Specifications of the American Society for Testing Materials; chairman of the Port Development Commission of Baltimore, 1920–1927; member of the committee appointed by the Mayor of Baltimore for the preparation of an Ordinance for the Electrification of the Pennsylvania Railroad in Baltimore; and member of the Maryland Water-Front Commission, appointed by the Governor of Maryland in 1928. He received the Society's Norman Medal in 1896 and its James Laurie Prize in 1915.

During the War he was a member of the National Council of Defense. He was also a member of the American Railroad Commission to Russia appointed in 1917 by President Wilson. As Bridge Expert of this commission he passed upon the strength and carrying capacity of all bridges on the Trans-Siberian and Russian railways.

He is a former president of the Engineers' Club of Baltimore, a former Director of the Society, and a former governor of the American Institute of Consulting Engineers. At present he is the president of the J. E. Greiner Company, Consulting Engineers, located in Baltimore, Md.

CHARLES L. STROBEL

CHARLES L. STROBEL was born in Cincinnati, Ohio, on October 6, 1852. He received his early education in the public schools of Cincinnati, which he left in 1869 to enter the Royal Institute of Technology at Stuttgart, Germany. Four years later he was graduated from this institution with the rank of civil engineer. After returning to this country, Mr. Strobel was employed from 1874 to 1878 as Assistant Engineer of the Cincinnati Southern Railway, in charge of theoretical work and design for the superstructure of bridges and viaducts. During this period and his subsequent bridge experience, he introduced into his work, probably for the first time in this country, the calculation of stresses based on definite locomotive wheel loads, followed by uniform train loads.

During the next 15 years he was successively employed as consulting engineer by the Keystone Bridge Company; Carnegie, Phipps and Company; and the Chicago, Milwaukee and St. Paul Railway. While thus engaged, he took a prominent part in the development of skeleton steel structures for Chicago office buildings, and designed a number of large bridges. From 1893 to 1905 he engaged in independent business as a contracting engineer, and the firm was later carried on as a corporation under the name of the Strobel Steel Company. In 1926 he withdrew from the contracting business. Throughout his professional experience he has contributed much to the development of movable bridges of the bascule and similar types.

No other contribution of Mr. Strobel has done more for the benefit of engineers and engineering than his outstanding work as author, compiler, and editor of the original and several later editions of the Carnegie *Handbook*. As stated in the preface, the first edition was a new work throughout. The tables, with few exceptions, were computed especially for this work, and some of them were original in both matter and form.

Mr. Strobel also designed the first "standard sections" for I-beams and channels and first proposed the rolling of Z-bars and the use of Z-bar columns. Those engineers whose experience dates back sufficiently will appreciate what benefit followed from the standardization of sections and connections. For this early preparation for publication of the dimensions, areas, and mathematical functions of structural sections, and other dependable information, all in convenient form for the use of designers and detailers, Mr. Strobel deserves the lasting gratitude of the engineering profession.

Long a Member of the Society, Mr. Strobel served as Director in 1886 and again, to fill a vacancy, in 1894. From 1911 to 1912 he was Vice-President. He is a member also of the Institution of Civil Engineers (London) and of the Western Society of Engineers.

Professional Records of Candidates for Office

ALONZO J. HAMMOND

ALONZO J. HAMMOND, the official nominee for President of the American Society of Civil Engineers for 1933, is a Hoosier, educated in the public schools at Frankfort, Ind. He graduated from Rose Polytechnic Institute in 1889, received the degree of M.S. in 1894, and that of C.E. in 1898. He also took a postgraduate course at the Massachusetts Institute of Technology in 1890–1891.

He carried on a general engineering and architectural practice at Frankfort until 1898, when he joined the Chief Engineer's staff of the Vandalia Railway for a period of three years at Terre Haute, removing in 1901 to South Bend, where he was City Engineer until 1910. During the same period he carried on a very wide practice in electric railways, hydro-electric plants, bridges, and municipal work.

In 1910 he went to Chicago as consulting engineer for the Commission on City Expenditures, reporting on the 14-ft. water tunnel at 73d Street. In 1911 he became Chief Engineer of the Bureau of Public Efficiency, investigating, among other things, the electrolysis of city water mains of Chicago. During 1912 and 1913 he was Engineer of Bridges and Harbor in the Department of Public Works, where he had charge of the design of a number of the important bridges, in particular the Lake Street and Michigan Avenue double-deck bascule bridges.

In 1914 he was engaged as consulting engineer for the Chicago Union Station and later became Assistant Chief Engineer in charge of engineering design and construction of that $75,000,000 passenger terminal.

Resigning this connection in 1922, he joined James O. Heyworth Inc., as Chief Engineer, and for three years was active in the design and construction of hydro-electric plants on the Mississippi, Chippewa, and Fox rivers.

For two years following this connection, he was Chief Engineer of the Mellon-Stuart Company, in the Chicago office, representing that company in the huge internal improvement program of Cuba.

Since then he has engaged in private practice as consulting engineer in Chicago, retained by the city on various projects such as river straightening, dock walls, bridges and viaducts, and also for other cities for grade separation and for passenger and river–rail terminals.

Mr. Hammond served as Director of the Society in 1926–1928, and as Vice-President in 1929 and 1930. He is a member of the American Institute of Consulting Engineers, the Western Society of Engineers, the American Railway Engineering Association, a member of the Executive Committee of the American Engineering Council, of the Chicago Engineers' Club, and of Board of Managers of Rose Polytechnic Institute.

He is a former president of the Chicago Local Section of the Society, and a former president of the Indiana Engineering Society.

FRANK O. DUFOUR

On New Year's Day, 1873, Frank Oliver Dufour was born in Washington, D.C. After graduation from Lehigh University with the degree of C.E. and two years of railway engineering experience, he entered the teaching profession. His alma mater first engaged his activities in this direction until 1902, when he accepted a position in the University of Wisconsin. Later he taught at the University of Illinois, leaving this position in 1913 to go into active engineering work.

After three years of railroad work, he became associated in 1916 with Stone and Webster as principal assistant to the Structural Engineer, and was promoted in 1922 to the position of Chief Structural Engineer. During the War, he was instrumental in the construction of the U.S. Ordnance Base in France and also served as special agent of the American International Shipbuilding Corporation, stationed chiefly in Canada.

In 1922 he joined the faculty of Lafayette College as Professor of Civil Engineering and Director of the Materials Testing Laboratory, maintaining at the same time a consulting engineering practice. In 1928, when the United Engineers and Constructors, Inc., was formed, he joined that company as consulting engineer. Since

he has been with it, he has passed on the design of many structures and foundations of the first magnitude, including office buildings up to 53 stories in height. Mr. Dufour is the author of several books on the design and construction of steel mills and bridges, as well as of numerous technical articles.

He has been active in Society affairs, having served as chairman of the Committee on Stresses for Structural Steel, as a member of the Joint Committee on Stresses for Structural Steel, and as a member of the Committee for the Standardization of the Yield Point for Structural Steel. He is a Society representative on the National Committee for Wood Utilization, a former member of the Society's Committee on Student Chapters, and a former president of the Lehigh Valley Section. From 1927 to 1930 he served as Director of the Society. He is a member of the Engineers' Club of Philadelphia and of the American Railway Engineering Association.

FRANK G. JONAH

A native of Canada, Frank G. Jonah was born in Albert County, New Brunswick, on October 6, 1864. He received his education in the high school at Moncton, N.B., and by private tutor. Also, he was a student for three years in the office of the Chief Engineer of the Intercolonial Railway, now part of the Canadian National Lines, and this period of study was supplemented by practical experience on surveys for branch lines.

His long and varied career in railway engineering began in 1887, when he accepted a position on the construction of government railways in Nova Scotia. Moving to St. Louis in 1890, he became Assistant Engineer on the St. Louis Merchants Bridge Terminal Railway. For the next decade he was employed largely in St. Louis in railway engineering capacities of increasing importance and responsibility.

From 1901 to 1903 he was Chief Engineer for the Blackwell, Enid and Southwestern Railway, now part of the St. Louis, San Francisco Railway Company (the "Frisco" System); and from 1903 to 1904 Chief Engineer of the St. Louis, Brownsville, and Mexico Railway. For the next year he served as Locating Engineer of the Frisco System. In 1905 he became Terminal Engineer for the New Orleans Terminal Company, holding this position until 1910 when he returned to the Frisco System. He was Chief Engineer of Construction until 1913, when he became Chief Engineer, a position he has held to date. During his professional career, Mr. Jonah has made surveys for 1,800 miles of railway lines and has been in charge of the construction of 1,000 miles.

During the World War, he served first with the Twelfth Engineers on the British front in France. Then, as the American Army organized its own Department of Light Railways, he became Chief Engineer of this department, with the rank of Lieutenant Colonel, Corps of Engineers. He served as Director of the Society from 1916 to 1917, when he was obliged to resign on account of his absence from this country with the A.E.F. Besides his Society affiliation, Colonel Jonah is a charter member of the American Railway Engineering Association and of the Society of American Military Engineers, of which he was president in 1931. In 1917 he served as president of the Engineers' Club of St. Louis.

JOHN P. H. PERRY

Born in San Antonio, Tex., on July 26, 1882, John P. H. Perry was educated at Trinity School, New York, and at Harvard University, from which he was graduated in 1903, with the degree of S.B. in Civil Engineering. From 1904 to 1906 he gained engineering experience, working on New York subway construction and on location surveys for the Ashokan Dam of the Catskill Water Supply System for New York City.

In May 1906 Mr. Perry entered the employ of the Turner Construction Company of New York, where he has been successively employed to date in the following capacities: assistant estimator; assistant superintendent; steel sales agent; contract manager; vice-president of the New York office; operating vice-president of the Chicago office; vice-president in charge of estimating, new business, contracts, and publicity for the New York office; and director and member of the executive committee. He is the author of almost eighty technical articles, chiefly on the subject of reinforced-concrete building construction.

In addition to being a former president of the New York Section of the Society, Mr. Perry is a former chairman of the Construction Division of the Society and a former member of the Technical Procedure Committee of the Society. He is also a former chairman of the Executive Committee of the Professional Engineers' Committee on Unemployment.

JAMES F. SANBORN

On September 5, 1876, James F. Sanborn was born on a sheep ranch near Sanborn, Colo. He was educated at the Cambridge Latin School and Harvard University, and was graduated from the Lawrence Scientific School in 1899, with the degree of B.S. in Mining and Metallurgy. After early experience in construction and designing work on water works for the Boston Metropolitan Water District and subway and elevated lines, he became associated with the New York Board of Water Supply in the construction of the Catskill aqueduct. For 13 years he maintained this connection.

From 1919 to date he has been a consulting engineer in New York City. During this period his experience has included the design and construction of water supply and sewer systems, tunnels, foundations, and concrete structures. He is the author of numerous engineering articles. In 1923 the Society awarded him the J. James R. Croes Medal for his joint authorship of the paper, "Engineering Geology of the Catskill Water Supply."

He is a member of the American Institute of Consulting Engineers, the American Water Works Association, the New England Water Works Association, and the New York and New Jersey sewage associations; and is chairman of Committee C-4, American Society for Testing Materials.

HENRY J. SHERMAN

On November 21, 1869, Henry J. Sherman was born at Mount Holly, N.J. After his graduation from Lehigh University in the class of 1890, with the degree of C.E., he served two years as an assistant in the Engineering Department of the District of Columbia and four years in the Philadelphia Department of Public Works. Since then he has engaged in general engineering practice.

While pursuing his private career, he has been placed in charge of numerous projects, some of which are of national importance. In 1908, for instance, as Chief Engineer of the Department of Inland Waterways, he had charge of constructing an inland waterway along the New Jersey coast from Cape May to Bay Head, a distance of about 120 miles. He was in charge of making examinations and reports on the boundary between New York and New Jersey and between New Jersey and Delaware. In 1922 he was chosen one of a board of engineers to make a study and report on the erosion and protection of New Jersey beaches. The findings on this subject have served as a guide in the design of coast-protection structures in foreign countries as well as in the United States.

He has served as director, vice-president, and president of the Philadelphia Section of the Society. Mr. Sherman is a member of the American Shore and Beach Preservation Association and of the Advisory Board of Engineers of the New Jersey State League of Municipalities. He has also been instrumental in forming and developing a New Jersey state society of engineers. He is a member of the Technical Advisory Committee on Comprehensive Plans and Future Crossings of the Delaware River, in the preparation of the Regional Plan of the Philadelphia Tri-State District.

OFFICIAL NOMINEES—1933

For President, Alonzo J. Hammond, of Chicago, Ill.
For Vice-Presidents:
Zone II, Frank O. Dufour, of Philadelphia, Pa.
Zone III, Frank G. Jonah, of St. Louis, Mo.

For Directors:
District 1, J. P. H. Perry and James F. Sanborn, both of New York, N.Y. (two to be elected)
District 4, Henry J. Sherman, of Camden, N.J.
District 11, Ralph J. Reed, of Los Angeles, Calif.
District 14, W. W. Horner, of St. Louis, Mo.
District 15, Edward N. Noyes, of Dallas, Tex.

Results of the final ballot will be announced at the Annual Meeting in January 1933

RALPH J. REED

A permanent resident of California since 1890, Ralph J. Reed was born in Port Huron, Mich., on April 30, 1883. He was graduated from Pomona College in 1905 and later entered the College of Engineering of the University of Michigan, graduating in 1908 with the degree of B.S. in Civil Engineering. In the autumn of that year he entered the employ of the Union Oil Company of California, where he remained until the close of 1929, serving in earlier years as an engineer in its transportation and sales departments, and from 1918 to 1929 as Chief Engineer in charge of all engineering design and construction and as executive head of its safety organization.

During these two decades he gained wide experience in the technical branches of the petroleum industry. Since the organization of the American Petroleum Institute he has been active in its technical affairs, particularly in matters of standardization, fire protection, and corrosion study. He also served for three years as a member of its General Standardization Committee and as national chairman of its Committee on Steel Tanks for Oil Storage. Since 1929 he has been engaged in private practice.

He is a former president of the Los Angeles Section of the Society, a member of the American Society of Mechanical Engineers and a member of the Executive Committee of its Los Angeles section. Mr. Reed is vice-president of the California State Board of Registration for Civil Engineers and a member of the Association of Professional Engineers of the Province of British Columbia.

WESLEY W. HORNER

Born in Columbia, Mo., on September 22, 1883, Wesley W. Horner was graduated from Washington University in 1905, with the degree of bachelor of science in civil engineering. Four years later he received the graduate degree of C.E. from the same university. In 1905 he began his long career of engineering service for the City of St. Louis by accepting a position in the water supply department. In 1908 he became Designing Engineer on the city's sewerage work and also made the first complete surveys for the Des Peres Drainage Works, later supervising the detailed plans and the construction, which is being completed in 1933. Since 1918 he has been Chief Engineer of Sewers and Paving, in responsible charge of engineering and all new construction of this type in St. Louis and of the supervision of all contracts.

While on leaves from the work at St. Louis, he has acted in an advisory capacity at the request of city engineers in a number of Mid-Western states, generally in connection with main sewerage and drainage problems. Mr. Horner is the author of numerous technical articles on municipal engineering problems.

He is a former president of the St. Louis Section of the Society, a former member of the Executive Committee of the Sanitary Engineering Division of the Society, and a former chairman of the Committee on Student Chapters and of the Committee on the Definition of Terms Used in Sewerage Practice. Besides these Society affiliations, he is a member of the American Concrete Institute and a former president of the American Society of Municipal Engineers, and has served as a representative to the American Engineering Council.

EDWARD N. NOYES

On September 15, 1880, Edward N. Noyes was born in Chase County, Kansas. He received the degree of B.S. in Civil Engineering from Kansas State University in 1907, and that of C.E. from the same university in 1925. From 1907 to 1912 he was in the employ of Hedrick and Cochran, bridge engineers, particularly on bridge construction involving difficult and unusual foundation problems. Since 1912 he has been a member of the firm of Myers and Noyes (later Myers, Noyes and Forrest), consulting engineers of Dallas, Tex.

The work handled by his firm has included municipal improvements; land reclamation by flood protection, irrigation, and drainage; city planning; and real estate development. During the World War, Mr. Noyes was engineer in charge of the construction of the Camp Travis cantonment of San Antonio and later served as assistant to the plant manager of the Hog Island Shipyard while that project was under construction.

For a number of years prior to 1928, Mr. Noyes served as secretary of the Texas Section of the Society. He is now chairman of the Executive Committee of the City Planning Division and of the Society's Committee on Juniors. From 1920 to 1924 he was a member of the committee of engineers advisory to the Governor of Texas.

A Celebration and an Anniversary

AMONG the Headquarters Staff, an extended continuous period of service is the rule rather than the exception. Perhaps the most notable example of this is presented by Miss Eleanor H. Frick, who has just completed her thirty-fifth year. For a long time she has been Office Manager and in that capacity has been responsible for a multitude of administrative details such as only an organization like the Society can occasion.

To handle the vast amount of mail, the office details connected with the election of members and officers, the Society's Reading Room, and Headquarters office; to oversee the clerical staff; and to be responsible for the purchase of supplies—these are merely a few of Miss Frick's duties. Any one who has had even a casual contact with these phases of the work knows that they are efficiently handled down to the last detail.

To celebrate this interesting occasion and bear witness to the respect and affection felt for Miss Frick, an informal luncheon party was held on Saturday afternoon, November 12, at the Hotel Roosevelt. About sixty were in attendance, largely present and former employees. Added interest was given by the presence of Lincoln Bush, Past-President and Honorary Member, who for five months when Vice-President and after the death of Secretary Dunlap acted more or less as one "of the staff." An appropriate scroll, signed by all members of the present staff, expressing their sincere admiration and good wishes, was presented to her. With the Staff, the Society as a whole may well "look forward to the continuance of our association" with Eleanor H. Frick.

Obtaining and Using R. F. C. Funds

A PAMPHLET of real merit, entitled "Federal Funds for Unemployment Relief and How to Get Them," has been prepared and is available for distribution by the National Committee for Trade Recovery. In it will be found a statement, in concise form, of the method of obtaining funds from the Reconstruction Finance Corporation for cities in need of water works and sewerage improvements. In it also will be found models of enabling acts which will offer valuable suggestions for use in those states where legislation will be required before the cities can avail themselves of such funds.

The National Committee for Trade Recovery is sponsored by the Construction League of the United States, which latter comprises 14 engineering, architectural, construction, and allied organizations, among them the Society. Representing the Society on the Executive Committee of the National Committee for Trade Recovery are John P. Hogan and Malcolm Pirnie, Members Am. Soc. C.E.

This pamphlet, which is recommended for careful reading by every engineer interested in public works for the relief of unemployment, may be obtained on request from L. J. Mulhearn, Executive Secretary, National Committee on Trade Recovery, 330 West 42d Street, New York, N.Y.

Appointments of Society Representatives

C. W. HUDSON, M. Am. Soc. C.E., has been appointed to represent the Society on the Board of Trustees of United Engineering Trustees for the three-year term beginning January 1933 and ending January 1936.

THADDEUS MERRIMAN, M. Am. Soc. C.E., has accepted an appointment to represent the Society on the John Fritz Medal Board of Award to fill the unexpired term of Anson Marston, Past-President Am. Soc. C.E., who has resigned.

JOHN P. HOGAN, M. Am. Soc. C.E., has been appointed a representative of the Society on the Board of the Engineering Societies Library.

Presidential Visits

ONE OF THE PLEASANTEST duties incumbent on the President of the Society is that of visiting numerous Local Sections in the course of his term of office. During the year, President Crocker has been privileged to do considerable traveling. In some instances his visits were for the sole purpose of meeting local groups of members and engineering students where no chapter exists, and in others they were incidental to his presence in the vicinity. In all, however, he was given a cordial welcome and was enabled to bring the greetings of the Society to the local group. These visits are shown on the accompanying map.

HEAD OF THE SOCIETY GOES VISITING
Engineering Groups Contacted by President Crocker During 1932

It is notable that a generous sprinkling of Student Chapters is included in the itinerary. Visits to such groups usually constitute a banner occasion for the college, and they are equally appreciated by the President as affording an opportunity for contact with future engineers and supporters of the Society.

Members of Executive Committees for Technical Divisions Elected Under New Method

ABOUT THIS TIME of year, members of the Technical Divisions of the Society are accustomed to look for individual ballots for the election of Division officers. In fact, they have frequently received several such ballots, one for each Division. The lack of economy of this wholesale postal expenditure has worried many good members who have not realized that considerable saving in labor is achieved by going straight through the various lists of Divisions, even though there are duplications, over what would be possible if the overlapping names had to be sorted out so that all ballots to a given member could be included in one envelope.

Even so, these ballots have been fairly expensive. Many of the necessary details have been known only to those who have acted as tellers. Such routine as checking of the names signed on the envelopes, elimination of those not eligible to vote, segregation into proper Division lists, and many other necessary minutiae were taken care of behind the scenes. Nevertheless, when added to the great outlay for postage to the member and return, they mounted in the aggregate to considerable sums.

All this procedure has now been superseded by a new arrangement. The Divisions still have their nominating committees, but the names selected are submitted to the Board of Direction instead of to the Division members. These recommendations are then acted upon, and new members for the Executive Committees are appointed by the Board. Announcement of the results of such elections was given in the November issue.

These remarks are addressed primarily to those Division members who may otherwise misunderstand their failure to receive the usual ballot. The working out of the new system is being watched with interest, in the expectation that it will constitute a forward step in the administration of the Divisions.

Cooperation Between Construction Organizations

THE GENERAL MEETING of the National Conference on Construction was held in Washington on October 13 and 14, 1932. Five special conference committees, which spent over a year in preparatory work, presented to the meeting a number of reports. These reports dealt with specific problems in the field of statistical and trade information, wastes and undesirable practices, economic relationships, realty finance, and local organization. In addition there were a number of talks on Federal aid to building for slum clearance, staggering employment in construction, and Reconstruction Finance Corporation loan policies.

Based on consideration and discussion of the committee reports, the conference on the second day adopted a number of conclusions and recommendations. Among the actions taken, the following resolution regarding cooperation with the Construction League of the United States was adopted:

WHEREAS, The National Conference on Construction was organized several years ago to survey construction problems resulting from the economic depression and to study the various relationships of construction to finance, real estate, transportation, and commerce; and

WHEREAS, The work of the Conference to date has had most gratifying results, both of a practical nature, and in bringing about a better mutual understanding between the groups engaged in construction and related groups in the field of finance, real estate, transportation and commerce, and has shown the outstanding need for carrying forward efforts of a similar type; and for making the most of the headway already gained; and

WHEREAS, Since the formation of the Conference there was organized in October 1931, the Construction League of the United States, designed to handle the internal problems of the construction industry;

Now, therefore, be it resolved, that in order to avoid duplication of effort and expense, it be recognized that the internal problems of the construction industry are within the sphere of the Construction League and that study of the external or inter-industry problems of the industry can be most effectively coordinated by the Chamber of Commerce of the United States through the National Conference on Construction or some similar method.

Be it further resolved, that the chairmen of the five general committees of the Conference, together with representatives of the Executive Committee of the Conference, and such others as the Chairman of the Conference's Executive Committee may designate, be constituted a committee to formulate a program for continuing the work of the Conference, this committee to report to the Chamber of Commerce of the United States and that pending such report this committee continue this coordination of the current inter-industry activities of the construction industry.

A Preview of Proceedings

In the December issue, readers of PROCEEDINGS *are again to be treated to a group of useful and interesting papers. First will come a presentation and discussion of the problem of controlling Colorado River silt at the proposed new diversion of the river to the All American Canal above Yuma, and the effect of this silt on the new lands to be irrigated. Next in order will come two more papers in the series on the George Washington suspension span over the Hudson River at Fort Lee, New York—one on the design of the superstructure, and the other on the design of the towers. The fourth paper in the issue will give the results of laboratory and field studies on the flow of salt water through fresh water, a problem requiring study wherever rivers enter tidal waters.*

TRANSPORTATION OF SOIL BY THE COLORADO RIVER

ONE of the most difficult irrigation projects to administer is that of the Imperial Valley in southern California, because of the enormous quantity of silt in the Colorado River, from which it receives its supply. In his thought-provoking paper, S. L. Rothery, M. Am. Soc. C.E., indicates the immensity of this problem by stating that the average quantity of suspended silt annually diverted near Yuma to the canal systems of the valley is over 24,000,000 cu. yd. In 1923, the amount of such silt reached a peak of over 40,000,000 cu. yd., or enough to cover 100 acres of ground 250 ft. deep. In addition to the silt in suspension, an unmeasured amount of bed sand and coarse silt, estimated at 4,000 acre-ft., has been transported as the annual bed load along the main canal. It is this bed load that causes the principal trouble.

The need of solving the problem of controlling the silt in the Colorado River at points of diversion is becoming more and more pressing. About 19 miles above Yuma the huge diversion works for the All American Canal to Imperial Valley is being planned, and there it is proposed to spend $3,750,000 for desilting works alone. The question arises, is this expense justifiable considering that the suspended silt would be useful in the irrigation of the 300,000 additional acres of sandy soil in Coachella Valley to seal up and give stability to porous canal banks, to reduce aquatic growths in the canals, and to supply additional surface soil, for which purpose it is claimed the silt has a definite fertilizing value?

It is Mr. Rothery's belief that the traveling bed load can be automatically removed by control works in the river above the diversion structure without the construction of desilting basins, but that the load of silt in suspension cannot be greatly reduced without huge and prohibitively expensive desilting basins, because a detention period of several hours would be required. After the construction of Hoover Dam in Black Canyon, the clear water that issues from the reservoir will pick up a new load of suspended silt that will decrease in amount as the regimen of the river becomes again stabilized, until after a few years it will disappear.

This and many other problems treated by Mr. Rothery deserve the earnest consideration of the best engineering irrigation engineers and the most thorough research for their solution. It is hoped that the paper will be widely discussed and that newly established findings will enable development to proceed on sound lines.

GEORGE WASHINGTON BRIDGE: DESIGN OF SUPERSTRUCTURE

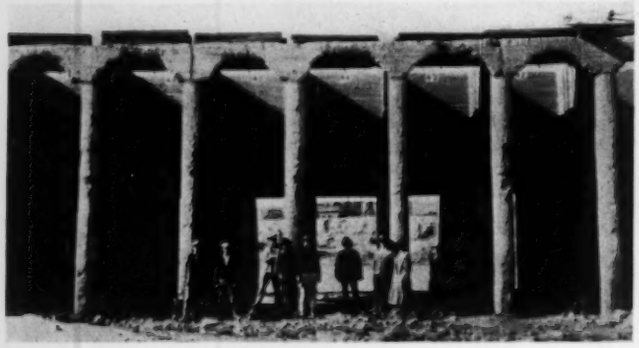
THIS, THE THIRD paper in the series on the George Washington Bridge, is by Allston Dana and Aksel Andersen, Members Am. Soc. C.E., and George M. Rapp, Assoc. M. Am. Soc. C.E. The first, by O. H. Ammann, M. Am. Soc. C.E., in the August PROCEEDINGS, described the general concept of the work. The second, by E. W. Stearns, M. Am. Soc. C.E., which appeared in PROCEEDINGS for October, dealt with the broad subject of contracts and construction procedure.

Beginning with a general description of the superstructure, the authors enter a discussion of primary dimensions and working unit stresses. A list of such stresses forms an important part of the paper. Then the authors proceed to the specific problem of designing the cables, the anchorages, and the suspenders. Each cable is composed of 26,474 galvanized steel wires laid parallel to form a compact cylinder 36 in. in diameter. The length of one cable, from strand shoes to strand shoes, is given as nearly one mile, and the total weight of wire in the four cables is 47,000,000 lb. The total length of single wire is about 105,000 miles, or enough to extend comfortably around the earth at the equator four times.

Test data are presented to show the forces in the cables, the towers, and the anchorages and the results of field measurements of strain to determine the intensity of the secondary stresses in the cables. The measurements were made on 150 wires on the periphery of the cables during different stages of construction, when the distortions were large and varying. The maximum pull in each cable at the anchorages is given as 62,000,000 lb., which is assumed equally distributed among the 61 strands and pairs of eye-bars. Nearly 2,500 strain measurements were made in the eye-bars that form the anchorages. Tabulated results of these measurements show that, as each new set of four strands was adjusted into place, it unloaded some of its stress on to the strands previously placed, the four lowest strands being stressed to as much as 40 per cent more than the average by the time the cable was completed.

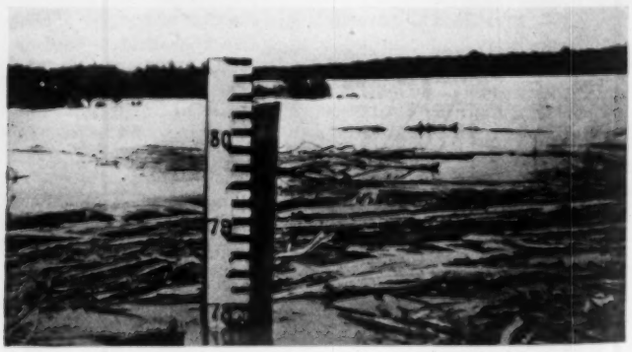
The paper also contains a description of the strand shoes, the anchorage and tower saddles, the cable bands, and the suspenders. The authors close their paper with a thorough description of the manner in which the floor system was designed, how the cables were wrapped, problems involved in designing roadway curbs and pavements, design features of the sidewalks and wind trusses, and an analysis of the wind system.

The accompanying photograph is a view of one of the tower saddles, which is 28 ft. long, 8 ft. wide, and 12 ft. high, and weighs 180 tons. The saddle rests on a bed of 33 eight-inch steel rollers, which are provided solely for the purpose of facilitating erection and for making future adjustments. An unusual feature of the bridge is the stiffening trusses, which are very flexible, having a ratio of depth to span of 1:120 in the center span and of 1:120



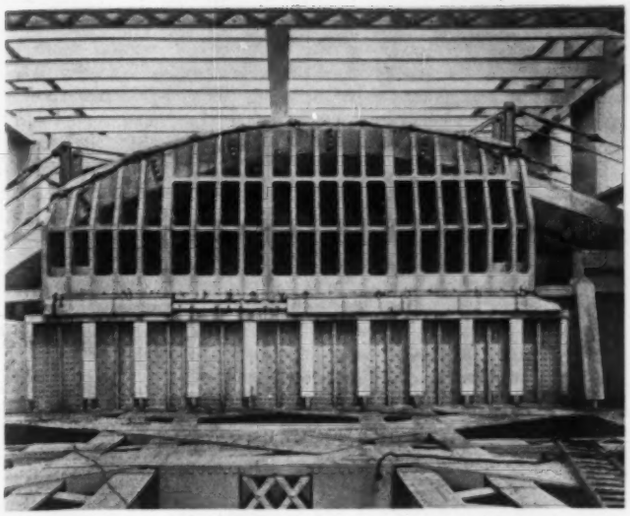
HANLON HEADING, COLORADO RIVER

Seventy-Six Such Openings Invite the Diversion of the Enormous Traveling Bed Load in the Colorado River Into the Canal System of Imperial Valley Except During Times of Flood



A COLORADO RIVER ANOMALY

Because of the Great Depth of Scour Into the Bed Silt, a Peak Discharge of 112,000 Sec-Ft. at 78-Ft. Gage Is Only 1.8 Ft. Above That for a Discharge of 30,000 Sec-Ft.



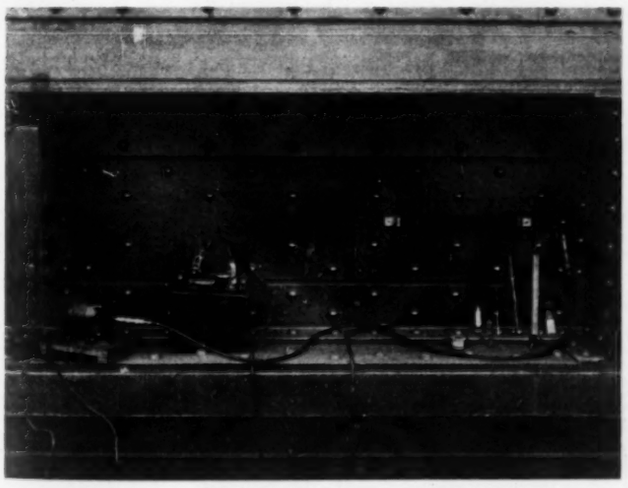
180-TON TOWER SADDLE, GEORGE WASHINGTON BRIDGE

and 1:118, respectively, in the New York and New Jersey side spans. As a result, they have no appreciable effect on the deformation of the cables except for very short and heavy loads, and even then their effect is slight.

GEORGE WASHINGTON BRIDGE: DESIGN OF THE TOWERS

THE FOURTH PAPER in this series on the George Washington Bridge, by Leon Moisseiff, M. Am. Soc. C.E., embraces a description of the problems encountered in designing the towers. Mr. Moisseiff points out that the evolution of thought as to the type of towers in any suspension bridge is a matter involving public opinion as well as technical judgment. The fact that the towers were conceived as ultimately to be encased in masonry is important to the understanding of their design and their relation to other phases of the entire problem. This factor, he states, determined the main feature and the novelty of the proportioning.

To reach a true conception of these forces, the tremendous size of the George Washington Bridge must be fully realized. The weight of the suspended structure and the vertical component of the anchorage pull (amounting to 112,000 tons on each tower),



MAGNETIC TEMPLATE FOR SPACING GAGE HOLES
Used on George Washington Bridge

the weight of the tower itself (amounting to 20,000 tons), and full wind pressure on the structure must be considered in the design.

The analysis of this tower is explained in detail by Mr. Moisseiff. He gives the method used to test the efficiency of the design, the stress-strain measurements on a celluloid model of a tower bent, and, what is of especial importance, the stress-strain measurements on the completed towers, giving an excellent comparison with analytical values. A particularly interesting phase of the paper is the description of the manner in which gage lines were spaced in making the strain measurements. The accompanying photograph shows the type of magnetic template used for this spacing.

The results of a joint investigation on large-size column sections by the Port of New York Authority and the National Bureau of Standards, according to Mr. Moisseiff, confirm the confidence of the engineers in the use of silicon steel and the box section for the tower columns of the bridge. The tests supplied information as to the behavior and strength of large fabricated columns and the efficiency of specific types of sections as compression members. The tests also established a direct comparison of three grades of structural steel in identical sections. This tower is of an unusual type. The entire load of the bridge is applied at the top of the inner column and is distributed between all columns as the stress proceeds downward, until finally the reaction on the masonry is practically uniform. The saddles that transmit the entire suspended weight of the bridge to the tower are placed above the inner columns. To have moved them outward so that they would be concentric with relation to all the columns on either side of the roadway would have involved an extra cost of $2,800,000.

MODEL LAW FOR MOTION OF SALT WATER THROUGH FRESH

IN ORDER to study the effect of fresh water flowing through salt water, or vice versa, the authors of this paper, M. P. O'Brien, Assoc. M. Am. Soc. C.E., and John Cherno, set up a model hydraulic channel, 24.4 ft. long, 0.5 ft. wide, and 1.25 ft. deep. The bottom was horizontal and the sides were of glass, with a coordinate system in feet and tenths of feet drawn with a grease pencil. The channel was divided into two compartments by a thin metal gate moving in vertical guides and sealed with rubber strips. The salt water in one compartment was colored a deep red with potassium permanganate, while the fresh water remained clear. When the gate was lifted suddenly, observations were made on the behavior of the two fluids with different specific gravities, and the findings of the paper are based on such studies.

Observations were also made on a widening channel as well as on one of constant cross section, and further observations were made in the field on a section of canal at Turlock, Calif. This irrigation canal was of trapezoidal cross section with a length of 2,600 ft. and a bottom width of 6 ft.

After finding an agreement between theory and experimental investigations, the authors determine an expression which they call "the model law" governing the similarity. This factor—involving the horizontal length of channel as numerator and the five-halves power of depth and the square root of the salinity as denominator—is a constant value, K. It is found that regardless of the absolute values involved, the velocity curves distribute themselves according to the value of K, which is given as a criterion for dynamical similarity.

As an illustration of the application of the conclusions in the paper, Messrs. O'Brien and Cherno analyze the possible distribution and dilution of salt water flowing from the Ballard Locks into the Lake Washington Ship Canal at Seattle, Wash., and compute the scale to be used in the construction of a model according to the model law derived in the paper. A lively discussion of this paper is expected.

News of Local Sections

CENTRAL OHIO SECTION

At a meeting held by this Section on October 20, R. R. Litehiser, secretary, presented the Model Registration Bill which had been received during the month from Headquarters. He also gave an informal report of the Fall Meeting of the Society at Atlantic City.

CINCINNATI SECTION

The first fall meeting of the Cincinnati Section was held on October 11. The subject chosen by Arthur Morgan, President of Antioch College, who addressed this meeting, was "Can Engineers Have Characteristic Ethics in Big Business." E. K. Ruth was elected vice-president to succeed John M. Belknap who resigned.

CLEVELAND SECTION

A committee of the Cleveland Section has made a study of, and report on, the subject of "Ethical Practices and Unemployment of Engineers." The report relates particularly to the practices of three groups of engineers: (1) professors and assistants in engineering schools supported by taxation, other public funds, or endowment; (2) salaried engineers employed by the Government and by states, counties, and cities; and (3) salaried employees of railroads, industrial corporations, and public utilities. There appeared to the committee to be abundant evidence that engineers in each of these groups solicit and secure professional clients, not only under their own names but also under the names of the organizations with which they are connected, and accept fees from them in addition to their regular salaries, using the personnel, the equipment, and often the time of the organization for the purpose.

This practice of doing work "on the side," the committee feels, reflects public discredit on the profession, results in competitive fee cutting to the point where it is profitable only to the one with an assured income, and is a contributing cause of the present unemployment situation among engineers. Confidence in the integrity of the profession cannot be established in the public mind if there is no display of honor among its members. The report considers the effect of these practices on consultants, surveyors, architects, and on mechanical, heating, chemical, and testing engineers, with their offices, personnel, equipment, and laboratories.

The Cleveland Section has recorded its sentiment against the practice of the engineers in these three classes in soliciting private engineering work in competition with practicing engineers and architects as unethical and detrimental to the standing of the engineering profession.

METROPOLITAN SECTION

The regular monthly meeting of the Section was held in the Engineering Societies Building, New York, November 16, with an attendance of about 325. On the technical program, W. J. D. Reid-Lewis, of the Engineering Institute of Canada, gave an illustrated lecture describing the successive chemical reactions that take place and the compounds that form during the manufacture of portland cement and its subsequent hydration in the concrete. Various aspects of this paper were discussed by Duff A. Abrams, Nathan C. Johnson, Lincoln T. Work, Thaddeus Merriman, and Mr. Paul, of the New York State Highway Department. Standard sieves containing 200, or even 325, meshes per linear inch for the gradation of particles of cement were declared inadequate as properly ground cement must be spoken of in terms of particle sizes in the neighborhood of 30 microns.

After the meeting refreshments were served, and a social hour was enjoyed.

MILWAUKEE SECTION

A meeting of the Milwaukee Section was held on May 19 at the City Club. The guest of honor for the occasion was E. D. Steinhagen, engineer for the S. M. Siesel Company, who presented an illustrated lecture on the pile driving and manufacture of piles for the Justice Building in Washington, D.C.

On September 30, a luncheon meeting of the Section was held at the City Club. The guests of the occasion were Herbert S. Crocker and Charles F. Loweth, President and Past-President of the Society, and the members of the Marquette Student Chapter. President Crocker outlined the present financial condition of the Society and also spoke of the work of the Society in furthering congressional action on the subject of a normal program of public works. Past-President Loweth recalled the Annual Convention of the Society in Milwaukee in 1888. One of the unusually interesting side trips made at that time was to Appleton, Wis., where members were actually privileged to see an electric street car in operation.

SEATTLE SECTION

The regular monthly meeting of the Seattle Section was held on September 26 at the Engineers' Club. There were 24 in attendance. After the routine business session, Mr. Pugsley gave an interesting account of his trip to the Yellowstone Convention of the Society.

SPOKANE SECTION

The Davenport Hotel was the scene of the regular monthly noon meeting of the Section, held on September 9. An instructive discussion of deep bridge foundations in the Northwest was presented by C. A. Burnette, a local contractor.

ST. LOUIS SECTION

About 50 members and guests attended the first meeting of the season of the St. Louis Section, held at the Hotel Mayfair on September 26. During the routine business session W. W. Horner reported on the award of the student prize for the best thesis written by one of the graduating class of engineers at Washington University. A committee was appointed to draw up a questionnaire to be sent out to all congressional candidates, asking them to state their positions on numerous questions directly and indirectly affecting the welfare of engineers.

Student Chapter News

GEORGIA SCHOOL OF TECHNOLOGY

Several interesting meetings have been held by the Georgia School of Technology during the past semester. A lecture on "Flood Control in the Miami Conservancy," illustrated by lantern slides, was given in three showings. Prof. Ralph P. Black was the lecturer, and the three meetings at which the lecture was presented were attended by all the members of the Chapter.

RHODE ISLAND STATE COLLEGE

On November 1, this Chapter held its third meeting, at which there were 28 members and guests present. An interesting illustrated lecture on the failure of the St. Francis Dam was given by Prof. Samuel Webster, and this was followed with a slide lecture by Dante Nardelli, on the subject of "Mississippi River Flood Control."

UNIVERSITY OF DELAWARE

The monthly meeting of the University of Delaware Student Chapter was held on October 24. Guest speakers at this meeting were: S. W. Sawin of the E. I. du Pont de Nemours Company; Isaac Walker, consulting engineer; and Thomas Watson, Principal Assistant Engineer of the Pennsylvania Railroad.

A European Appreciation of John R. Freeman

FROM CZECHOSLOVAKIA comes the following letter addressed to the Society, expressing the high regard of the engineers of that country for the late John R. Freeman, Hon. M. Am. Soc. C.E.

Prague, November 4, 1932

American Society of Civil Engineers
29 West Thirty-Ninth Street
New York

Gentlemen,

We have just received the sad news of the death of the distinguished engineer, Mr. John Ripley Freeman.

We are deeply moved by this afflicting event. The deceased has, to our great joy, paid several visits to our country and has each time left here traces of his great experience and sincere sympathy to us in giving us advice which greatly helped us to accomplish our hard task.

He was in truth an engineer of the world, whose work found application in many distant countries of the globe.

His rare gift of observation and his constructive mind enabled him to solve the most difficult engineering problems.

By his tactfulness, his generosity and kindness of heart as well as the purity of his character, he also won friendship among men.

His works, many of which are deposited in our library as his personal gift, testify of the many-sidedness of his spirit and work.

He belonged rightly to the most distinguished members of the Masaryk Academy of Work.

We all, without exception, regret deeply the loss which suffered your noble country, your profession and we too, by the demise of this remarkable man and engineer.

His memory will live in our hearts for evermore.

Please accept kindly our sincere expression of condolence together with the assurance of our great esteem.

We are, gentlemen,

Yours sincerely

MASARYK ACADEMY OF WORK

The President:

(Signed) ZIMMLER

Ing. Dr. H. c. E. Zimmler

Index to Vol. 2 of Civil Engineering

SINCE THE SECOND volume of CIVIL ENGINEERING is completed with the December 1932 number, the index for the entire volume is fittingly bound in with this issue. It was felt that the difficulty of publishing a complete index to include the present number would be more than offset by the obvious advantage to those readers who wish to bind their copies immediately on receipt of the final number of the volume.

Readers will note that the index is on a separate and complete form and that, by opening the binding staples, it can be removed intact without clipping any pages. If it is removed in this way, it can be easily transferred to the front of the volume for binding.

Some readers may wish to divide the volume in two parts for binding, in which case it will be convenient to include an index at the beginning of each of the two bound parts. For this purpose reprints of the index are available and may be obtained at the regular reprint rate of 15 cents each on request to Headquarters.

Those who are planning to bind their file of CIVIL ENGINEERING should also remember that the advertising sections are paged separately, so that, when they are removed, the paging of articles and departments is continuous throughout the volume.

For the sake of appearance, a sheet has been added to the beginning of the index so that when bound into the front of the volume it will form a fitting title page. No effort has been spared to make the index itself complete. In it articles and items are listed both by subjects and by authors, and there are a generous number of cross references. It is hoped that the index, as arranged, will not only make the past 12 issues of CIVIL ENGINEERING more convenient for use, but also will facilitate the binding and permanent retention of Vol. 2 by interested libraries and readers.

American Engineering Council

National representative of 27 engineering societies, with a constituent membership of 62,000 professional engineers, reports civil engineering news of the Federal Government

ANNUAL MEETING OF ASSEMBLY

The annual meeting of the Assembly of the American Engineering Council will be held in Washington, D.C., January 12–14, 1933.

ADVISORY ENGINEERS TO RECONSTRUCTION FINANCE CORPORATION APPOINTED

In accordance with its previously announced plan to add engineer members to the district advisory committees, the Reconstruction Finance Corporation has recently extended invitations to 43 well known engineers to serve on the committees of their respective districts. The names of the engineers, together with the loan agencies on the advisory committees of which it is proposed that they serve, are as follows:

NAME	LOAN AGENCY	NAME	LOAN AGENCY
McDonald, F. H.	Atlanta	Blossom, Francis	New York
Thurlow, Oscar G.	Birmingham	Adams, Everett E.	Omaha
Lee, William S.	Charlotte	Follin, James W.	Philadelphia
Hammond, Alonzo J.	Chicago	Henny, D. C.	Portland
Sando, Will J.	Chicago	Barrows, H. K.	Boston
Hawley, John B.	Dallas	Spofford, Charles M.	Boston
Noyes, Edward N.	Dallas	Sowers, G. B.	Cleveland
Crocker, Herbert S.	Denver	Hoffmann, Robert	Cleveland
Hubbell, Clarence W.	Detroit	Gregory, Wm. B.	New Orleans
Thomson, Francis A.	Helena	Myers, B. S.	Okla. City
Cummins, Robert J.	Houston	Saville, Allen J.	Richmond
Youngberg, Gilbert A.	Jacksonville	Beers, W. D.	Salt Lake City
Stayton, Edward M.	Kansas City	Galloway, John D.	San Francisco
MacCrea, Don A.	Little Rock	Huber, Walter L.	San Francisco
Bent, Arthur S.	Los Angeles	Shannon, W. D.	Seattle
Cory, H. T.	Los Angeles	Fisken, John B.	Spokane
Brigman, Bennett M.	Louisville	Brown, Baxter L.	St. Louis
Shenehon, Francis C.	Minneapolis	Hallihan, J. P.	Detroit
Wheeler, Walter H.	Minneapolis	Mickey, C. E.	Omaha
Dyer, Arthur J.	Nashville	Fernald, Robt. H.	Philadelphia
Hogan, John P.	New York	Jacobs, Joseph	Seattle
Fuller, George W.	New York		

[All but four of these appointees are members of the Society.]

In the letter of invitation, Harvey Couch, Director of the Reconstruction Finance Corporation, said in part:

"The applications of the smaller projects will very likely come through the local offices while the larger ones will come directly to us here. However, we want the benefit of the reactions, suggestions, and opinions of men who are well acquainted with such projects. In this way, we also hope to avoid the necessity of long trips for the small applicants coming here simply for information in connection with filing their applications. Your participation does not entail engineering work or making plans, but advice and counsel. There is no compensation except remuneration for travel."

PROGRESS IN AUTHORIZING SELF-LIQUIDATING LOANS

The month of October showed progress in the way of making loans available for self-liquidating projects. As of November 1, loans aggregating $134,634,120 had been authorized for 24 such projects. These loans include the following:

$40,000,000 for the Los Angeles Aqueduct of the Metropolitan Water District of Southern California.

$3,500,120 for 11 miscellaneous water supply projects ranging in size from $29,000 for a water supply for Columbia, Ky., to $1,491,000 for the water supply project of Seattle, Wash.

$78,590,000 for four bridge projects, including $62,000,000 for the San Francisco Bay Bridge.

$105,000 for a municipal light and power plant for Madison, N.D.

$7,260,000 for two flood-control and irrigation projects in Texas.

$1,072,000 for three sewerage projects.

$3,957,000 for a housing project in New York.

$150,000 for a dock and warehouse in Gulfport, Miss.

The corporation has emphasized its desire to make loans on small projects in order to provide for the greatest possible distribution of relief. It is an encouraging sign that two thirds of the loans so far authorized are for amounts of less than one million dollars. It has also been pointed out that the authorization of a loan by the Reconstruction Finance Corporation does not always provide for immediate employment, as in many cases the construction of the project must be delayed until the grantee has removed local legal or financial obstacles.

STATES UTILIZE FEDERAL AID IN HIGHWAY CONSTRUCTION

More than $72,000,000 of the $120,000,000 made available for emergency Federal-aid road construction under the terms of the Emergency Relief and Construction Act had been allocated for specific projects up to October 29, according to an announcement made November 3 by the Bureau of Public Roads. Additional projects have been approved in regional offices of the bureau and are ready for the approval of the central office.

To expedite the work the states are being permitted to begin construction without waiting for the formality of approval of their projects by the central office, provided the district engineer of the Bureau has approved the plans. The money used for this work constitutes a temporary advance of funds, and the Government is to be reimbursed by making deductions from Federal-aid apportionments over a ten-year period beginning with 1938.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for January

MEASURED BY American standards, Mediterranean cities require a surprisingly small quantity of domestic water, averaging less than 40 gal. per capita. Athens, however, has long suffered from a thoroughly inadequate supply carried by the ancient Hadrian Aqueduct, built from 115 to 130 A.D. Due to a rapid influx of refugees from Central Europe in 1922 the population of Athens and environs increased to 800,000 and the already overtaxed water supply system could no longer begin to meet the need. The Greek Government, after being advised by both native and foreign engineers, in 1925 awarded an engineering, construction, and finance contract to the American firm of Ulen and Company to build the Marathon Dam, a marble structure about ten miles northeast of Athens, and a gravity tunnel and conduit to convey the water to the city. The distribution system was thoroughly modernized so that Athens now has a supply which is up to date in every respect. The January number of CIVIL ENGINEERING will contain an article describing the basis of design and the difficulties of construction of the project, by R. W. Gausmann, M. Am. Soc. C.E., who designed these works and now has charge of their operation.

In the April 1932 issue of CIVIL ENGINEERING there appeared an article by Oren Reed, Assoc. M. Am. Soc. C.E., presenting observations based on the examination of 25 Scandinavian dams of masonry construction. A second article by the same author is scheduled for the January issue. In it Mr. Reed will outline the main causes of disintegration and damage in the severe climate of Scandinavia and will describe the remedial measures applied and their effectiveness.

Methods of mapping forest areas and cruising timber in Montana will be presented by O. W. White, Assoc. M. Am. Soc. C.E., formerly State Cruiser. When Montana initiated an effort to conserve its natural resources, Mr. White was entrusted with the development of a plan and the organization of forces for the detailed examination of all state owned lands, upwards of a half million acres. Although most of this area had been sectionized by the General Land office, details of topography, cover culture, stream data, and geological conditions were not available. Resort was had to pacing and such hand instruments as the clinometer, compass, and the "Biltmore" stick, with satisfactory results, using a survey party consisting of only a compassman and a cruiser.

Forecasts of the behavior of hydraulic works are more and more being made by means of scalar models. In the Middle Rio Grande Conservancy District, the Cochiti Diversion Works, a low overflow weir 235 ft. long, is one of four structures to divert water from the Rio Grande for irrigation purposes. Before designs were completed, models of the ogee curve of the dam at a scale of 1:10 were tested in a flume to determine their relative effectiveness in keeping the "jump" on the discharge apron and reducing the scour of the river bed below it. The author of this article, A. W. Newcomer, Assoc. M. Am. Soc. C.E., not only conducted the experimental work but, as resident engineer, supervised the construction of the structure itself, now complete.

Other articles are available and are being planned for publication in the January issue, among them one on traffic problems, one on reinforced concrete design, and one on subway construction.

This issue will also contain the complete program for the Annual Meeting of the Society, to be held at the Engineering Societies Building in New York, January 18–21, 1933. Thus the practice initiated a year ago of replacing the separate 4 by 8-in. program folders by a more generous display in the pages of CIVIL ENGINEERING will be continued. Look for the complete program of the Annual Meeting in the January issue. Those who wish separate reprints of this program may secure them by request to Society Headquarters.

Cornell University Awards Fuertes Medal

WALTER LORING WEBB, M. Am. Soc. C.E., has been awarded the Fuertes Graduate Gold Medal by the engineering faculty of Cornell University for the work which he did in preparing the ninth edition of his work on railroad construction and the engineering tables complementing the same. Although the medal may be awarded annually, this is only the second time it has been awarded since 1925.

The Page of Special Interest

AT THE FRONT of each issue of CIVIL ENGINEERING, a page has been devoted to some special feature—a striking bridge, a fine view of water flowing over a dam, a unique piece of engineering construction, an inspiring bit of poetry, or an interesting piece of prose, or perhaps an example of amateur art by an engineer. In the present issue, the subject of the special page comes in the last of these categories.

It is from a collection of snapshots taken by Charles H. Stevens, M. Am. Soc. C.E., during the Annual Convention of the Society held at Yellowstone Park last July. His lens has caught, most fortunately, the Yellowstone River in its grandest tumultuous mood. Its rushing waters leap from the rock wall of the Great Falls; huge veils of mist climb high up on the adjacent sides of the gorge and then, boiling and turbulent, the "white water" in the valley below speeds on its long way to the sea. The picture is one of a great river in action. All other details simply form an appropriate background that serves only to intensify the river. It is a picture of rare activity. The figures on the observation platform just under the great white patch of snow at the left of the falls, emphasize the insignificance of man beside the magnificence of nature.

Extensive Service Rendered by Engineering Library

WITH ITS 150,000 volumes on engineering and its 2,000 technical periodicals, the Engineering Societies Library each year is assisting 40,000 people to find the specific information they seek. According to Harrison W. Craver, Director of the Library, the depression has stimulated the study of American engineering practice by foreign engineers, so that technical information is being supplied to nearly every nation in the world.

Inquiries from New Zealand are numerous and relate for the most part to public works. Requests for aid also come from Soviet Russia, both from Soviet and American engineers there, indicating an increasing reliance on this country in the development of the Russian industrial system. Although the demands from industry itself for technical assistance have fallen off, the number of readers has increased by 10 per cent in recent months. Each year the Library supplies translations, photostats, and service to 15,000 persons who are unable personally to visit the book stacks.

Improving Relationships in the Construction Industry

THE NATIONAL CONFERENCE ON Construction, which held its general meeting in Washington, D.C., in October, received, among others, a report from its committee on the basic defects which exist in the building industry. According to the committee, this report deals with fundamental economic relationships for which a satisfactory solution must be found if the industry is to operate on a sound basis, and therefore the following outline of the report is reproduced here for the information and benefit of readers. The report refers specifically to the construction of buildings, but is also applicable in its analysis to engineering works, in which case the word "Engineer" would be substituted for the word "Architect."

"1. In building construction, greatly added ultimate cost and unsatisfactory

performance result from the failure of the Owner to limit the bids to competent and experienced contractors. There should be complete understanding between the Owner and the Architect with respect to the eligibility of the contractors who are asked to compete for the work. After this understanding is arrived at, it should be rigorously enforced. Relationships with incompetent bidders usually result in delay, inferior workmanship, and financial controversy. A mistaken impression prevails among some owners that it is possible to secure a low price through the mistake of an incompetent bidder. It is obvious that the economies resulting therefrom are false and inevitably prove disastrous to the Owner.

"2. The preparation of a comprehensive estimate and proposal involves serious expense. It is natural that the duplication of effort that results from the presentation of bids by an excessive number of bidders results in a substantial economic loss.

"3. Insufficient investigation on the part of bonding companies and the Owner; lack of information, and lax standards of materials suppliers in their credit practices, result in artificially establishing responsibility for financially weak general contractors and sub-contractors. This permits them to engage in work for which they are not well qualified.

"Lien laws in many states make it possible for a vendor of material to a Contractor to collect from an Owner for this material, even though the Owner has already paid the Contractor for the same material. This makes it possible for vendors of material to disregard the credit standing of the Contractor to whom he sells, and destroys the advantage that a Contractor of high credit rating should enjoy.

"4. Employment by the Architect or the Owner of inexperienced and incompetent inspectors not qualified to pass on construction details and lacking in practical construction judgment results in lack of cooperative effort between the contractor and the inspector, and in the case of an unscrupulous contractor permits the execution of work inferior to that which is specified. This in turn places an unfair burden on the contractor who desires to observe ethical standards.

"5. Carelessly drawn and indefinite specifications make it possible for a contractor to make claims for unnecessary and unforeseen extras, or to reduce the cost of the work at a severe sacrifice of the quality. This places the ethical contractor at a great disadvantage in presenting his bid, since a contractor desiring to maintain a high reputation must refuse to adopt such shrewd and questionable tactics.

"6. Loose and non-comprehensive specifications are frequently the result of the failure of the Engineer and Architect to maintain a close contact with competent contractors, sub-contractors, and materials producers who are familiar with the latest practices and possess the best cost data.

"7. In the design of important buildings, serious losses frequently occur through the failure of the Owner and Architect to call in as consultants, in the early consideration of the project, experts in the field of construction, finance, and building operation.

"8. A tendency on the part of general contractors to use unscrupulous methods in obtaining a price less than that officially bid by the sub-contractors usually involves financial loss to the sub-contractor and inferior work for the Owner. Sub-contractors are also guilty in permitting and even encouraging this cutting under their bid figures after the bids have been submitted.

"9. Many of the above defects are due to the lack of a cooperative relationship between the Owner, the Architect, and the General Contractor.

"10. In the construction of large office buildings, the General Contractor has often been employed on an agency or semi-professional basis for the purpose of securing better cooperation between Contractor, Architect, and Owner, a system which has many advantages in this field of work. Many possible advantages are nullified, however, when the contractor attempts to assume the dual rôle of professional adviser on one contract and competitive operator on another contract simultaneously and thereby exposes himself to the temptation of using his most efficient workers on the lump sum or competitive job; also, when he undertakes the purchase of materials or performance of sub-contract operations for profit on a job which he is handling on a professional basis."

Philadelphia Engineers See Evidence of Business Recovery

OF ALL the many indications that business has taken a turn for the better the one most acceptable to those still idle is the reemployment of some of their number. The Philadelphia Technical Service Council has recently found a noticeable increase in the number of requests for engineering personnel and in the number of men returned to work through its efforts. A total of 150 men have been definitely placed to date. Of this number, 40 are now with municipal and civic organizations on made work financed from a fund subscribed by individual engineers and engineering societies. A movement is now on foot to raise $60,000, and it is planned to extend this type of service until 200 engineers with dependent families can be cared for.

The Philadelphia Technical Service Council is made up of the State Employment Commission of Pennsylvania, the Engineers' Club of Philadelphia, and the local sections of the 12 national engineering societies listed below:

American Society of Civil Engineers
American Society of Mechanical Engineers
American Society of Heating and Ventilating Engineers
American Society of Municipal Engineers
American Society of Steel Treating
American Institute of Electrical Engineers
American Institute of Chemists
American Chemical Society
American Welding Society
Illuminating Engineering Society
Society of American Military Engineers
Association of Iron and Steel Electrical Engineers

The combined membership of this local group, including the Engineers' Club, is 5,000 members. The council has entrusted the management of its activities to six members, who form the Philadelphia Technical Service Committee. Employment activities are carried on by a non-salaried staff of five volunteers from among the unemployed technical men, and thus this service is offered without charge to any one. To date over 1,100 applicants have registered for employment at 1317 Spruce Street, Philadelphia, Pa., and executives requiring engineering personnel are directing their inquiries there.

Conference on Asphalt Paving Announced

THE TENTH ANNUAL Asphalt Paving Conference is to convene in the Roosevelt Hotel at New Orleans on Monday, December 5, to continue throughout the week. It is being held under the auspices of the Asphalt Institute and the Association of Asphalt Paving Technologists. As arranged, the program will be of considerable interest to all engineers and technologists engaged in highway construction and maintenance or in the testing and inspection of highway materials. Among the problems to be considered are those of low cost roads, road mix versus plant mix, hot mix versus cold mix, and the use of emulsions for surface treatment and maintenance.

Blasting to Hasten Settlement of Fills

AN EIGHTY-PAGE VOLUME has just been released for distribution to interested readers by the Hercules Powder Company. The title, *Accelerating Swamp Fill Settlement with Explosives*, is completely descriptive of its contents. The method, which is gaining favor in this country, is adequately explained in all its details. The booklet contains information and data on all known successful methods of producing fill settlement. It is profusely illustrated with photographs, diagrams, and drawings, and includes cost data hitherto not generally available. The book can be used as a guide for determining and putting into execution the most successful method of using explosives in highway construction. An inquiry addressed to the Hercules Powder Company, Wilmington, Del., will bring the booklet without cost.

NEWS OF ENGINEERS

From Correspondence and Society Files

EARL G. DOBBINS has taken a position with the Tennessee Department of Highways, Cleveland, Tenn.

CLIFFORD B. COX, who was formerly connected with the Sanitary District of Chicago, is now employed in the consult-

ing office of Charles H. Hurd in Indianapolis.

ROBERT B. B. MOORMAN, until recently special research assistant in the Department of Theoretical and Applied Mechanics of the University of Illinois, has accepted a position at the University of Mississippi as assistant professor of civil engineering.

LEO C. BROOKS, who has been employed as Draftsman in the construction office of the Rock Island Lines, in Trenton, Mo., has now accepted a position with the Oklahoma State Highway Department, with headquarters in Walters, Okla.

ARTHUR F. DANIEL has accepted a position as Fire Analyst with the fire department of the City of Dallas, Tex.

C. E. HAVEKOTTE, formerly in the employ of the Southern Surety Company of New York, has now become associated with the Home Indemnity Company of the same address.

M. P. VON HOMEYER has accepted a position in the Texas State Highway Department, with headquarters in Austin.

CHARLES M. WEBB is now engaged in structural engineering work for the Terrell Bartlett Engineers who are located in San Antonio, Tex.

LUIS A. DELIZ, who was formerly an Assistant Engineer with the Board of Transportation, New York, has accepted a new position in the same capacity with the Department of the Interior of Puerto Rico, with headquarters in San Juan.

WURTH KRIEGEL has resigned his position as Research Fellow, U.S. Bureau of Mines, University of Washington, to enter the employ of Gladding, McBean and Company of Renton, Wash.

MELVILLE DOZIER, JR., for the past seven years manager of the Southern California Chapter of the Associated General Contractors of America, has recently resigned that position to engage in private consulting engineering practice, with offices in Los Angeles.

RAYMOND ARCHIBALD, formerly of Albany, Ore., has accepted a position in the Bridge Department of the Department of Public Works, Boise, Idaho.

F. P. WENTZ has become connected with the Union Pacific System. Previously he was Valuation Engineer for the Oregon-Washington Railroad and Navigation Company.

GERARD H. MATTHES, formerly Principal Engineer in the U.S. Engineer Office of the War Department, located at Norfolk, Va., has recently been transferred to the Mississippi River Valley where he is Principal Engineer in the office of the President, Mississippi River Commission, Vicksburg, Miss.

OTIS M. JERNIGAN has taken a position in the U.S. Engineer Office in New Orleans, La.

WM. GUY WILLIAMS and THOMAS E. BROWN, JR., formerly associate engineers with Waddell and Hardesty, have formed a partnership to be known as Williams and Brown, Consulting Engineers, New York, N.Y. They will specialize in the design of fixed and movable bridges.

R. E. COUGHLIN, who has been employed as an instructor in the State University of Iowa, has resigned to become Assistant to the District Engineer at Rock Island, Ill.

JAMES N. TRUE has accepted a position as Junior Engineer with the Illinois State Highway Department and is located in Woodstock, Ill.

FRANK FRENCH has entered the employ of the Texas Railroad Commission, Utilities Appraisal Division, Austin, Tex.

JOHN M. WINSTON has accepted a position as Assistant Engineer, Division No. 2 of the Texas Highway Department, with headquarters in Fort Worth, Tex.

A. B. MCDANIEL, formerly secretary-treasurer of the Research Service, Inc., has reorganized the organization under the name of "The Research Service," of which he is now the head. He is also continuing his consulting practice.

HOMER A. HUNTER, who has been office and field engineer for Hawley, Freese, and Nichols of Cambridge, Mass., has accepted a position as sales engineer for the Northern Pump Company of Minneapolis.

JOHN OBERLY DAVIS has been promoted from the position of Acting Office Engineer to Office Engineer for the Lago Petroleum Corporation of Maracaibo, Venezuela.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From October 10 to November 9, 1932

ADDITIONS TO MEMBERSHIP

ABBEY, CHESTER EDWARD (Jun. '32), 7030 Ethel Ave., St. Louis, Mo.

ALOFF, ABRAHAM MARTIN (Jun. '32), Examiner, Div. of Civ. Service, Commonwealth of Massachusetts, Room 152, State House, Boston, Mass.

BARCLAY, ROBERT KENNEDY (Jun. '32), 420 Third St., Oakmont, Pa.

BARTE, GEORGE RUSSELL (Jun. '31), Insp., Levee Constr., U.S. Govt., Box 40, Sherard, Miss.

BAUGH, ELBERT ANSEL (Assoc. M. '32), Gen. Mgr., Texas Branch, Associated Gen. Contrs. of America, 308 Construction Bldg., Dallas, Tex.

BERSIG, WALTER CHARLES (Jun. '32), Eng. Asst., Board of Transportation, 250 Hudson St., New York (Res., 1343 East 29th St., Brooklyn), N.Y.

BOOKMAN, MAX (Jun. '32), 447½ South Chicago St., Los Angeles, Calif.

BROOKS, LEONARD (Jun. '32), 1911 North 32d St., Philadelphia, Pa.

CAPONE, RALPH GEORGE (Jun. '32), Junior Civ. Engr., State Highway Dept.; 27 Roma St., Nutley, N.J.

CASEY, JOHN JAMES (M. '32), City Engr., City Engr.'s Office, San Francisco, Calif.

CASPAR, FERDINAND EDWARD (Jun. '32), Asst. Engr. (Junior), City of Orange (Res., 227 Henry St.), Orange, N.J.

COLLINS, ALBERT BERNHARDT (Assoc. M. '32), Insp., Los Angeles County Flood Control Dist., Los Angeles (Res., 6629 Arbutus Ave., Huntington Park), Calif.

COLLINS, WILLIAM TAFT (Jun. '32), 2 Bond Pl., Cincinnati, Ohio.

CRESSWELL, FREDERICK SORENSEN (Jun. '32), 321 McGregor Ave., Cincinnati, Ohio.

CURRAN, CHARLES DANIEL (Jun. '32), School of Civ. Eng., Cornell Univ., Ithaca, N.Y.

DOUBITZKY, AARON (Jun. '32), Care, Kutai, 31 West 88th St., N.Y.

ELLIS, BRUCE WILLIAM (Jun. '32), 417 West Delavan Ave., Buffalo, N.Y.

FROST, EARL THOMPSON (Assoc. M. '32), Asst. Engr., Cuyahoga County Surveyor's Office, Cleveland (Res., 14418 Fischer Rd., Lakewood), Ohio.

FUTRAL, ALLEN ASHLEY (Jun. '32), 102 West Anderson St., Savannah, Ga.

GREER, ROBERT COLLINS, JR. (Assoc. M. '32), Hometown, Tamaqua, Pa.

GRIBBIN, JOHN BRESLIN (Jun. '32), 857 Stuyvesant Ave., Trenton, N.J.

HANNAH, DAVID MACMORRAN (Jun. '32), West Main St. Rd., Batavia, N.Y.

HANSMAN, ARTHUR FRANCIS (Jun. '32), Asst. Engr., Grade 2, State Dept. of Public Works, Div. of Highways, Albany (Res., 94 Eller Ave., Buffalo), N.Y.

HARKER, JOSEPH CLYDE (Jun. '32), 116 North Plymouth Boulevard, Los Angeles, Calif.

HAWKS, RALPH WAITE (Jun. '32), 54 Townsend Ave., Newburgh, N.Y.

HAY, FRANCIS HAYNES (Assoc. M. '32), Chf. Hydrographer, Los Angeles Flood Control Dist.; 2821 North Chevy Chase Drive, Glendale, Calif.

HERBERGER, ARTHUR HENRY (Jun. '32), 309 East 164th St., New York, N.Y.

HILL, ROBERT FARRIS (Jun. '32), 44 Walnut Ave., Dalton, Ga.

HOBBS, WILLIAM, JR. (Jun. '32), Union Bridge, Md.

HOPE, OWEN MORLEY (Assoc. M. '32), Cons. Engr., Wesley Chambers, Victoria St., Hamilton, New Zealand.

HUBKA, VENCEL ANTHONY (Jun. '32), 512 South Union St., Traverse City, Mich.

HUEBNER, CARL HERMAN (Jun. '32), 57 Eleventh Ave., Newark, N.J.

HURTGEN, HAROLD RAY (Jun. '32), 4808 Austria St., St. Louis, Mo.

JENS, STIFEL WILLIAM (Jun. '32), 7028 Kinsbury Boulevard, University City, Mo.

JOHNSON, CHARLES HERBERT (M. '32), Asst. Chf. Engr., N.C. & St. L. Ry., 924 Broadway (Res., 2214 Belmont Boulevard), Nashville, Tenn.

JONY, EMERICH (M. '32), Engr., Commonwealth of Pennsylvania, Dept. of Health (Res., 446 West Mt. Airy Ave.), Philadelphia, Pa.

KABRICH, CHARLES EDWARD (Jun. '32), Box 319, Blacksburg, Va.

KAMPMEIER, ROLAND AUGUST (Jun. '32), 1315 Elmhurst Drive, N.E., Cedar Rapids, Iowa.

KEHART, MARTIN WILLIAM (Assoc. M. '32), Field Engr., Lakeside Bridge & Steel Co., Box 167, Benld, Ill.

KERN, LOUIS JOSEPH (Jun. '32), 4215 Seventy-Ninth St., Elmhurst, N.Y.

KES, ANTHONY, JR. (Jun. '32), 930 Bloomfield St., Hoboken, N.J.

LAMBRECHT, RICHARD WALDO (Assoc. M. '32), Engr., H. G. Christman-Burke Co., Norwalk, Ohio.

LAMOREAUX, RAYMOND (Jun. '32), Stop 17, Troy Rd., Schenectady, N.Y.

LANE, THOMAS ALPHONSUS (Jun. '32), 2d Lieut., Corps of Engrs., U.S.A., Fort Humphreys, Va.

LANIGAN, JOHN JOSEPH (Jun. '32), P.O. Box 344, Catholic Univ., Washington, D.C.

LEMMON, ALLEN BOSLEY, III (Jun. '32), 1116 Ramona St., Palo Alto, Calif.

LEWIS, GEORGE NEEDHAM, JR. (Jun. '32), Insp., State Roads Comm. (Res., 2108 Boone St.), Baltimore, Md.

LO PINTO, VICTOR JOSEPH (Jun. '32), R.F.D. 1, Mahopac, N.Y.

LYNN, AARON VERNON (Assoc. M. '32), Asst. Engr., Springfield Water Works, Cobble Mountain Reservoir, Blandford, Mass.

MCMAHON, HARRY RAYMOND (Jun. '32), 1323 Seventy-Seventh St., Brooklyn, N.Y.

MANN, JOSEPH (Jun. '32), Constr. Supt., Prescott-White Corporation (Res., 1110 Anderson Ave.), New York, N.Y.

MATSEK, JOHN (Jun. '32), 413 Pine St., Roselle, N.J.

MATTHEWS, JAMES FREDERICK (Assoc. M. '32), Cons. Engr. and Appraiser, 215 Montague St., Brooklyn, N.Y.

MITCHELL, HARRINGTON CALKINS (Jun. '32), 814 Linden Ave., Wilmette, Ill.

NELSON, HARRY LEGRAND (Jun. '32), 74 Edgemont Rd., Scarsdale, N.Y.

NOLTE, CHARLES BEACH (M. '32), Pres. and Gen. Mgr., Robert W. Hunt Co., Engrs.; 175 West Jackson Boulevard, Room 2200, Chicago, Ill.

PREZIOSO, GEORGE SILVIO (Jun. '32), 9212 One Hundred and Seventh Ave., Ozone Park, N. Y.

PRICHARD, MASON CARTER (Assoc. M. '32), Associate Engr., U.S. Engr. Office, Jacksonville, Fla.

REEDY, OLIVER CALMAR (Jun. '32), 2340 Dahlia St., Denver, Colo.

REUTER, BERNARD VINCENT (Jun. '32), 26 Court St., Room 2304 (Res., 1942 Haring St.), Brooklyn, N.Y.

RICE, CLAUDE HAYES (Jun. '32), R.F.D. 5, Dover, N.H.

ROBINSON, GEORGE SYDNOR (Jun. '32), 201 Washington Ave., Saugerties, N.Y.

RUDDER, SAMUEL MILLER (M. '32), Div. Engr., State Highway Dept., 907 Moreau Drive, Jefferson City, Mo.

RUDDY, JOHN MICHAEL (Jun. '32), 8425 One Hundred and Thirteenth St., Richmond Hill, N.Y.

RUNCK, ROY RUDOLPH (Assoc. M. '32), Res. Engr., Wilbanks & Pierce, Inc., New Madrid, Mo.

SCOTT, HOMER JUDKINS (Jun. '32), 1098 Worcester Ave., Pasadena, Calif.

SETTLE, JOSEPH EDWARD (M. '32), Cons. Engr., 3 Manor Pl., Charleston, W.Va.

SMITH, FREDERICK ANDERSON (Jun. Oct. '32), 478 Morris St., Albany, N.Y.

SMITH, HERBERT EDWARD (Jun. '32), Eng. Asst., Board of Transportation; 111 Gates Ave., Brooklyn, N.Y.

SNELLINGS, HERBERT GLEMM (Jun. '32), Box 541, Blacksburg, Va.

SPRINGER, JOHN PUGH (Jun. '32), Junior Structural Engr., Veterans' Administration; Ramona Hotel, Palo Alto, Calif.

STOUTENBERG, JOHN HENRY (Jun. '32), 337 Lenox Rd., Brooklyn, N.Y.

SUTHERLAND, DONALD CLARENCE (Jun. '32), 610 Washington Ave., Trinidad, Colo.

THOMAS, ROBERT SCOFIELD (Jun. '32), Junior Engr., U.S. Bureau of Reclamation; 3751 Harrison Boulevard, Oakland, Calif.

UKER, VERNE WALTER (Assoc. M. '32), Asst. Eng. Mgr., Sales Eng. Dept., Shell Petroleum Corporation, Shell Bldg., St. Louis, Mo.

VON KÁRMÁN, THEODOR (M. '32), Prof. and Director, Aeronautical Laboratory, California Inst. of Technology, Pasadena, Calif.

WEDDINGTON, CHARLES FOREMAN (Jun. '32), Office Engr., State Highway Dept., Box K, Refugio, Tex.

WELTNER, WILLIAM (Assoc. M. '32), Chf. of Field Party, City Engr's Office (Res., 12450 Barlow Ave.), Detroit, Mich.

WERNER, WILLIAM MURRAY (Assoc. M. '32), Constructor, Box 908, Shreveport, La.

WESTERFELD, STUART CLARENCE (Jun. '32), 365 Elder Lane, Winnetka, Ill.

WILSON, ROBIN STUART (Assoc. M. '32), 1021 West 32d St., Los Angeles, Calif.

WILSON, WARREN ELVIN (Jun. '32), 199 Central Ave., Madison, N.J.

WINELAND, JEFF ANDREW (Jun. '32), Junior Engr., Bureau of Reclamation; 2301 Cedar St., Berkeley, Calif.

XAVIER, JULIO FRANCIS, JR. (Jun. '32), 131 Franklin St., Bristol, R.I.

YOUNG, PHILLIP GAFFNEY (Jun. '32), City Engr., Box 25, Refugio, Tex.

MEMBERSHIP TRANSFERS

ALLEN, GLENN HAROLD (Jun. '22; Assoc. M. '32), Chf. Designing Engr., International Steel Co. (Res., 516 South Runnymede Ave.), Evansville, Ind.

ALLMOND, DAVID ROBINSON, JR. (Jun. '26; Assoc. M. '32), Sales Representative, Am. Bitumuls Co., 330 Washington St., San Diego, Calif.

ANDREWS, ALFRED STOKES (Jun. '28; Assoc. M. '32), Dist. Engr., U.S. Fidelity & Guaranty Co., Cleveland (Res., 21612 Kenwood Ave., Rocky River), Ohio.

ASHLEY, WELLS HINE (Assoc. M. '26; M. '32), 514 Kincaid Ave., Sumner, Wash.

BHIROMYA, TATT MAKARA (Jun. '29; Assoc. M. '32), Acting Maintenance Engr., Royal State Rys. of Siam, Bangkok, Siam.

BOWLER, EDMOND WESLEY (Assoc. M. '24; M. '32), Prof. and Head of Dept. of Civ. Eng., Univ. of New Hampshire, Durham, N.H.

BROWN, FREDERICK THEODORE (Jun. '25; Assoc. M. '32), Constr. Engr. and Cost Appraiser, Title Guarantee & Trust Co., 176 Remsen St., Brooklyn (Res., 11 Highland Pl., Waverly Hills, Little Neck), N.Y.

COOK, RUDOLPH (Jun. '27; Assoc. M. '32), Engr.-Insp., City Aqueduct Dept., Board of Water Supply (Res., 2285 Andrews Ave.), New York, N.Y.

COTTER, CARL HENRY (Jun. '16; Assoc. M. '24; M. '32), Lt.-Commander, C.E.C., U.S.N., Bureau of Yards and Docks, Navy Dept., Washington, D.C.

COVERT, NEWELL SERINE (Assoc. M. '27; M. '32), Asst. Engr., Transit Comm., 270 Madison Ave., New York (Res., 194 Main St., Cold Spring-on-Hudson), N.Y.

DAVIS, FRANCIS MARION (Jun. '28; Assoc. M. '32), Asst. Div. Engr., State Highway Dept., Paris, Tex.

FITHIAN, WILLIAM ROBBINS (Jun. '29; Assoc. M. '32), Topographical Instrumentman, Mo. Pac. R.R.; 4145 Locust, Kansas City, Mo.

FOWLE, ROYAL EDGAR (Jun. '20; Assoc. M. '32), Engr., Granite Rock Co., Drawer M, Watsonville, Calif.

HUNNICUTT, JAMES MADISON (Jun. '27; Assoc. M. '32), Contr. Engr., Virginia Bridge & Iron Co., 404 Builders Bldg., Charlotte, N.C.

JARRETT, JAMES MAURICE (Jun. '28; Assoc. M. '32), Special San. Engr., U.S. Public Health Service, Box 56, La Fayette, Ga.

KAROLAK, ALPHONSE (Jun. '27; Assoc. M. '32), Asst. Engr., Grade 1 (S.D.), Div. of Engr., State Dept. of Public Works, Albany (Res., 333 Mansion St., West Coxsackie), N.Y.

LAND, RICHARD IRVING (Jun. '27; Assoc. M. '32), Asst. to Purchasing Agt. and Contr. Mgr., Marc Eidlitz & Son, Inc., 100 East 42d St., New York (Res., 3 Langdon Lane, Mamaroneck), N.Y.

LOESER, JESSE JOHN (Jun. '26; Assoc. M. '32), 95 Tuers Ave., Jersey City, N.J.

MCLOUGHLIN, FREDERIC OZANAM XAVIER (Jun. '14; Assoc. M. '20; M. '32), Associate Prof. Civ. Eng., School of Technology, Coll., City of New York (Res., 400 West 160th St.), New York, N.Y.

MCPHERSON, ALBERT MORTIMER (Assoc. M. '18; M. '32), Engr. Representative, National Water Main Cleaning Co.; Cons. Engr., Room 7, Kahn Bldg., Wichita Falls, Tex.

MAY, DONALD CURTIS (Jun. '14; Assoc. M. '18; M. '32), Civ., Hydr. and Elec. Engr. (Ayres, Lewis, Norris & May), Cornwell Bldg., Ann Arbor, Mich.

MOORE, FRED LAWRENCE (Assoc. M. '22; M. '32), 236 South Burnett St., East Orange, N.J.

MORRELL, BEN. (Assoc. M. '24; M. '32), Lt.-Commander, C.E.C., U.S.N., Care, L. A. Morrison, Bureau of Yards and Docks, Navy Dept., Washington, D.C.

NEFF, NAT HARRY (Assoc. M. '25; M. '32), Chf. Engr., Orange County Planning Comm.; County Engr., Orange County (Res., 422 West Santa Clara Ave.), Santa Ann, Calif.

PATTON, DAVID HAMMOND (Jun. '27; Assoc. M. '32), Dist. Representative, Johns-Manville Sales Corporation, 626 North 9th St. (Res., 3220 Pawnee Ave., Apartment 4), Birmingham, Ala.

PUGSLEY, EDMOND FOLSOM (Assoc. M. '25; M. '32), Hydr. Engr., 6203 Brooklyn Ave., Seattle, Wash.

RINGWOOD, THOMAS EDWARD (Assoc. M. '28; M. '32), Pres., J. W. Hennessy, Inc.; Chf. Engr., Montauk Beach Development Corporation, Fisher Bldg. (Res., West Lake Drive), Montauk, N.Y.

RIVIERE, JAMES ANDREW (Jun. '26; Assoc. M. '32), Project Engr., State Road Dept., Callahan, Fla.

SCOTT, WARREN JOSEPH (Assoc. M. '25; M. '32), Chf. Engr., State Dept. of Health (Res., 947 West Boulevard), Hartford, Conn.

SHERMAN, EDWARD PRESSLEY (Jun. '26; Assoc. M. '32), Engr. and Salesman, Jones & Laughlin Steel Co., Cincinnati, Ohio (Res., 81 Crescent Ave., Fort Thomas, Ky.).

SHIELS, THOMAS DAVID (Jun. '28; Assoc. M. '32), Field Engr., Portland Cement Assoc., Box 847, Abilene, Tex.

SPURR, JEROME LYON (Jun. '27; Assoc. M. '32), Asst. Engr., Met. Dist. Water Supply Comm., Box 222, Enfield, Mass.

STANSEL, HORACE SYLVAN (Assoc. M. '20; M. '32), Civ. Eng., Box 156, Ruleville, Miss.

STEWART, FRANCIS ALEXANDER (Jun. '28; Assoc. M. '32), Topographical Draftsman, Grade 4, Borough of Richmond; 4568 Spuyten Duyvil Parkway, New York, N.Y.

TORKELSON, FRANCIS ARTHUR (Assoc. M. '31; M. '32), City Engr. (Res., 2167 North 69th St.), Wauwatosa, Wis.

REINSTATEMENTS

JAMESON, JOHN ALEXANDER, JR., Jun., reinstated Oct. 8, '32.

RESIGNATIONS

AASS, ASBJORN HJALMAR, Assoc. M., resigned Nov. 1, '32.

ANDERSON, LYTTLETON COOKE, M., resigned Oct. 20, '32.

BRUA, ELMER GEORGE, Assoc. M., resigned Nov. 5, '32.

BURKART, EDWIN HOWARD, JR., Assoc. M., resigned Oct. 31, '32.

GUNN, JOHN PATTERSON, Jun., resigned Oct. 24, '32.

JOHNSON, WILLIS CANTEY, Jun., resigned Nov. 2, '32.

LEIGHTON, MARSHALL ORA, M., resigned Oct. 31, '32.

LESLIE, SYDNEY CLYDE, Jun., resigned Oct. 26, '32.

LINDHÉ, JOHN BIRGER, Assoc. M., resigned Oct. 28, '32.

MOORSHEAD, OLIVER, Assoc. M., resigned Oct. 12, '32.

POOLE, LESTER JACKSON, Assoc. M., resigned Oct. 24, '32.

ROSE, ALSTON ORANGE, Assoc. M., resigned Oct. 11, '32.

VAN DIEST, EDMOND CORNELIS, M., resigned Oct. 20, '32.

WALKER, EDSON OZRO, Assoc. M., resigned Oct. 31, '32.

WEINERT, FERDINAND JACOB FREDERICK, Assoc. M., resigned Oct. 24, '32.

DEATHS

BOWKER, WILLARD LEWIS. Elected M., June 3, 1903; died Sept. 18, 1932.

CLAUSSEN, OSCAR. Elected M., Oct. 2, 1901; died Oct. 26, '32.

DAVIS, ARTHUR LINCOLN. Elected Jun., Apr. 4, 1893, Assoc. M., Oct. 7, 1896, M. Mar. 6, 1906; died Oct. 19, 1932.

DEWITT, PHILIP HOFFECKER. Elected M., May 5, 1897; died Oct. 5, 1932.

GRAVES, EDWARD MICHAEL. Elected Assoc. M., Mar. 2, 1909, M. Apr. 2, 1913; died Oct. 1, 1932.

HAYWARD, HARRISON WASHBURN. Elected Assoc. M., June 6, 1906, M., May 5, 1915; died Oct. 18, 1932.

IRONS, CHARLES WILLIAM. Elected Jun., Nov. 23, 1931; died March 5, 1932.

JAMIESON, JOHN QUINTIN. Elected M., Nov. 6, 1889; date of death unknown.

KNOWLES, MORRIS. Elected Jun., Oct. 4, 1892, Assoc. M., Jan. 1, 1896, M. Apr. 1, 1903; died Nov. 8, 1932.

LEDOUX, JOHN WALTER. Elected M., June 5, 1895; died Nov. 7, 1932.

LORDLY, HENRY ROBERTSON. Elected M., Oct. 11, 1920; died Oct. 4, 1932.

MELTON, ARTHUR POMEROY. Elected Assoc. M., Sept. 5, 1911; M., June 2, 1920; date of death unknown.

TEMPEST, JOSEPH EDWARD. Elected Assoc. M., Mar. 16, 1925; died Sept. 12, 1932.

VISSER, WILLIAM RIENZE. Elected Jun., Oct. 1, 1926; died July 28, 1932.

WINTERER, FRANK HERMAN. Elected Assoc. M., June 9, 1930; died Sept. 15, 1932.

TOTAL MEMBERSHIP AS OF NOVEMBER 9, 1932

Members	5,820
Associate Members	6,281
Corporate Members	12,101
Honorary Members	19
Juniors	2,866
Affiliates	117
Fellows	5
Total	15,108

Men Available

These items are from information furnished by the Engineering Societies Employment Service with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fees is to be found on page 97 of the 1932 Year Book of the Society. Unless otherwise noted, replies should be addressed to the key number, Engineering Societies Employment Service, 31 West 39th Street, New York, N.Y.

CONSTRUCTION

CIVIL ENGINEER, Assoc. M. Am. Soc. C.E.; 30; graduate; 8 years experience with contractor, in designing, estimating, and construction of subways, foundations, and industrial buildings. Willing to go anywhere. Experienced in the following: design and construction of bracing systems for deep excavations; design and construction of underpinning structures; estimating for above; and surveying for construction. D-1619.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 34; single; graduate of Lafayette College; experienced in railroads, power lines, buildings, bridges, and road and reinforced concrete construction. Available at once. Location East or South. D-1636.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 30; married; B.C.E. from Ohio State University; 4 years experience in surveying; 1 year in drafting and design of water treatment plants and sewage disposal plant; 7 months as resident engineer on construction. Location immaterial. Available immediately. D-1648.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 38; vast experience in direction of building construction of every type; good organizer; knows how to handle men, subcontractors. Understands commercial aspects of construction business, prices. Accurate, reliable, independent worker; fast estimator; layout man. Knows six foreign languages perfectly. Could do translation from and into English. D-1592.

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; graduate of Columbia University, 1900. Licensed professional engineer, New York State. Chief engineer on contracts, covering, since 1902, tunnels, reservoirs, dams, sewers, and water works. Considerable experience as expert on valuation of water companies, and expert witness on law suits arising out of interpretation of specifications. Can give references. D-1637.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 27; single; graduate of Ohio State University; 2 years experience in field construction for by-product coke plants; 3 years in railway track maintenance; 1 year varied experience drafting, sanitary engineering field work, and research testing of various building materials. Prefers position with any type of transportation organization. Location United States or foreign. C-8472.

DESIGN

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 37; married; graduate; state licenses; 10 years experience, surveying, design, and construction. Railroad, highway, parkway, harbor, and tall building projects. Completely familiar with design of rigid frame bridges, reinforced concrete or steel, single or multiple span, square or skew. Available immediately. D-1496.

STRUCTURAL ENGINEER; Jun. Am. Soc. C.E.; 28; single; graduate; 1½ years designing and detailing subway structures (Philadelphia); 4½ years designing and detailing all types of railroad and highway bridges. Location desired, Eastern states. Available immediately. D-1672.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 30; married; licensed professional engineer; graduate of Rensselaer Polytechnic Institute; 8 years with consulting engineer, 2 years in charge; thoroughly experienced in design, detail, and specifications of fixed and movable bridges, especially vertical lift; structural design for buildings; excellent draftsman; proficient checker of shop drawings; available immediately. D-506.

SANITARY AND SALES ENGINEER; Assoc. M. Am. Soc. C.E.; licensed New Jersey sanitary engineer; college graduate, with 10 years experience in design and construction of sanitary works with consulting engineer and contractor, and in manufacturing, promoting, and selling concrete pipe. C-874.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; married; B.S. in C.E.; 5 years experience in erecting, detailing, and designing of steel structures. Location immaterial. Available immediately. D-1675.

EXECUTIVE

MUNICIPAL AND SANITARY ENGINEER; Jun. Am. Soc. C.E.; 31; married; graduate of University of Michigan; 2 years assistant city engineer; 2 years with large consulting firm, designing and supervising construction of water works, sewers, and sewage treatment plants; 2 years engineering accountant. Licensed in two states. Location immaterial. Available immediately. D-700.

ENGINEERING EXECUTIVE; M. Am. Soc. C.E.; 15 years experience in design and supervision of construction of various types of municipal work; executive officer, secretary, and treasurer of engineering firm. Extensive experience stocks, bonds, and investments. Will consider position as purchasing agent, trust officer, or in engineering department of bank, etc. Location immaterial. Moderate salary. D-251.

MUNICIPAL AND SANITARY ENGINEER; M. Am. Soc. C.E.; 38; married: licensed professional engineer; 13 years experience in responsible charge of water supply, filtration plants, sewerage and sewage treatment works, municipal engineering, power plants, and public utility valuations; 5 years experience as city engineer. Investigations, reports, design, and construction. Location immaterial. Available immediately. B-9270.

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 8 years varied structural experience—drafting, design, construction, inspection, surveys, layouts, and related work. Readily adaptable to new conditions. Desires any suitable connection, preferably with construction company, consultant, contractor, or architect, field or office; also sales-engineering or instructorship. C-2605.

STRUCTURAL ENGINEER; M. Am. Soc. C.E.; 39; married; graduate C.E.; licensed; executive; 18 years experience in structural designing, managing steel fabricating plant, and selling. Last 8 years head of consulting engineering office, specializing in structural designing for architects, owners, and contractors. Large acquaintance among architects and contractors in northern New Jersey. A-5489.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; licensed professional engineer, State New York; 25 years experience in design and construction of steam and hydro-electric power plants, transmission lines of all capacities—including 220,000 volts—industrial plants, electric railways, valuations, estimates, specifications, and purchasing. Desires responsible charge of work. Location New York. B-5423.

ENGINEER; M. Am. Soc. C.E.; graduate C.E.; Lehigh University; 24 years experience in the design and construction of all kinds of steel and reinforced concrete structures, over 19 years in executive capacity. Specialist on large buildings, last 5 years in consulting practice. Any reasonable offer accepted, preferably in New York or vicinity. D-1664.

INDUSTRIAL ENGINEER AND ARCHITECT; M. Am. Soc. C.E.; graduate, licensed. Design and construction of chemical and other manufacturing plants, hydro-electric developments, housing groups, commercial garages, stores, and office buildings. Experienced in organization of office staffs, and supervision and control of office and field forces. B-2835.

INDUSTRIAL ENGINEER; M. Am. Soc. C.E.; 18 years experience on the design and construction of plant extensions and improvement, maintenance and operation of industrial and heavy chemical plants, investigation and economic reports on industrial and utility steam and hydro-electric power developments. Consulting experience on industrial and power developments. C-6336.

ENGINEER; M. Am. Soc. C.E.; 41; industrial, mechanical, and construction; experience in complete industrial plants and power stations, investigations, reports, planning, design, building, construction, operation, selling. Justified plant improvements and economic layouts, manufacturing methods, and processes. Engineering reports for use in connection with mergers, consolidations, sale or purchase of industries and other properties. Satisfactory references. A-1185.

IRRIGATION ENGINEER; M. Am. Soc. C.E.; graduate C.E.; last 10 years as chief engineer and in consulting work on projects involving investigation, design, construction, and operation, including design and construction of important storage works; 5 years foreign service. Any location. C-5225.

JUNIOR

JUNIOR ENGINEER; Jun. Am. Soc. C.E.; 25; graduate of University of Missouri, B.S. in C.E.; 1 year experience in sewer construction, field and office; 9 months railroad experience. Desires position with consulting or sanitary engineer. References upon request. Location immaterial. Available immediately. C-7529.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; single; graduate of the College of the City of New York, C.E. degree; 1 year on line and grade and construction of subaqueous compressed air tunnel; 1 year estimating on subway construction; 1 year teaching surveying. Desires any engineering position. Location immaterial. D-971.

GRADUATE CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; single; graduate of Rensselaer Polytechnic Institute, 1930, C.E. degree; 1½ years sales experience. Desires position with construction company or in any civil engineering work. Salary and location secondary. Available immediately. D-949.

GRADUATE CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; master's degree; 8 months experience in municipal engineering and 1½ years experience in structural steel business. Available immediately for work in any locality. Work for master's degree in hydraulics and water power. Speaks and reads German. D-1663.

RESEARCH

GRADUATE SANITARY ENGINEER; Jun. Am. Soc. C.E.; 28; single; B.S. in sanitary engineering, Massachusetts Institute of Technology; 1 year of experience in structural design; 1 year in laboratory; desires position, preferably with opportunity to do research on original modification of activated sludge process. Location immaterial. Available immediately. D-1613.

SALES

STRUCTURAL AND SALES ENGINEER; Assoc. M. Am. Soc. C.E.; 39; married; graduate. High class sales executive. Long experience in sales, sales management, designing, detailing, and estimating bridges and buildings. Seeking connection with building material manufacturer or distributor, also engineering position with general contractor. Available immediately. Capable and forceful. D-16.

STRUCTURAL ENGINEER EXECUTIVE; M. Am. Soc. C.E.; 45; married; broad engineering and sales experience in structural steel fabricating business; also 3 years as general contractor on industrial plant work. Particularly well qualified to handle district representation for steel or other lines of building construction materials. C-5095.

STRUCTURAL ENGINEER SALES EXECUTIVE; M. Am. Soc. C.E.; experienced in designing structural steel and ornamental iron for both riveted and welded construction; also experienced in estimating, costs, burden application, and sales. B-7445.

SALES REPRESENTATIVE; Jun. Am. Soc. C.E.; with New York City office facilities, desires to handle products of building material or industrial concerns. Graduate engineer from Massachusetts Institute of Technology, with 7 years practical experience in sales, design, construction, and research and a wide acquaintance among engineering firms and public utilities. C-5233.

TEACHING

PROFESSOR OF CIVIL ENGINEERING; M. Am. Soc. C.E.; American-born; Presbyterian; Ph.B., B.S., M.S., and C.E.; open for position, preferably mechanics, structures, or highways; 20 years engineering experience; 4 years teaching. Qualified personally. B-5954.

STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 36; married; graduate of Massachusetts Institute of Technology; 11 years experience in design, supervision, and construction of bridges, buildings, and water-front terminals, including responsible charge; also 3 years teaching experience in engineering subjects. Responsible position in design or supervision of construction, or assistant professorship desired. C-9716.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; New York State license; wide experience as engineer and executive in heavy construction, harbor works, investigation, and reports; S.B. at Massachusetts Institute of Technology, supplemented at Columbia this year by complete review in class of basic subjects in civil engineering and observation of teaching methods. C-1689.

RECENT BOOKS

New books of interest to Civil Engineers, recently donated by the publishers to the Engineering Societies Library, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 87 of the Year Book for 1932. The statements made regarding the books are taken from the books themselves and this Society is not responsible for them.

DESIGN OF STEEL BUILDINGS. By H. D. Hauf. New York, John Wiley & Sons, 1932. 222 pp., diagrs., charts, tables, 9 × 6 in., cloth. $2.75.

A concise presentation of the general principles of structural steel design as applied to apartment houses, schools, offices, institutional buildings, and other common types. The book comprises the course given to students of architectural engineering in Yale University.

HANDBUCH DER GEOPHYSIK. Edited by B. Gutenberg. Band 4, Lieferung 3: Erdbebengeographie, by A. Sieberg. Berlin, Gebrüder Borntraeger, 1932. pp. 687–1005, diagrs., maps, tables, 11 × 7 in., paper. Subscription price 56 rm.; single price 84 rm.

The third section of the volume on earthquakes in this handbook is devoted to a study of the geographic distribution of earthquakes and to the resulting theoretical and practical problems. All the available earthquake observations are recorded and re-examined. There are numerous maps.

IRRIGATION PRINCIPLES AND PRACTICES. By O. W. Israelsen. New York, John Wiley and Sons, 1932. 422 pp., illus., diagrs., charts, maps, tables, 9 × 6 in. Cloth, $5.

A description of modern irrigation methods and practices. The book discusses the conveyance and use of irrigation water, the properties of soils and the behavior of water in them, the efficient application of irrigation to various crops, and similar topics bearing on the subject.

DIE KORROSIONSSCHWINGUNGSFESTIGKEIT VON STÄHLEN UND IHRE ERHÖHUNG DURCH OBERFLÄCHENDRÜCKEN UND ELEKTROLYTISCHEN SCHUTZ. (Mitteilungen des Wöhler-Instituts Braunschweig, Heft 10). By E. Hottenrott. Berlin, NEM-Verlag, 1932. 62 pp., illus., diagrs., charts, tables, 8 × 6 in., paper, 3.60 rm.

This pamphlet is a report of an investigation of the part played by corrosion in reducing the fatigue resistance of various steels. It reviews briefly previous investigations of the question, describes apparatus for testing specimens exposed simultaneously to corrosion and repeated stresses, and gives the results of tests on carbon steels. The effect of cold-rolling on corrosion is also discussed.

MACRAE'S BLUE BOOK, consolidated with Hendricks' Commercial Register. 40th Annual Edition. Chicago and New York, MacRae's Blue Book Company, 1932–1933. 3,333 pp., illus., 11 × 9 in., cloth, $15.

A buying guide for manufacturers, railroads, mines, municipalities, public utilities, contractors, engineers, and mills. Materials are carefully classified, and a good index is provided. There are also a directory of manufacturers and local distributors, a section describing the trade facilities in towns of more than one thousand inhabitants, and a directory of trade names. A section is devoted to Canada.

MODERN MATERIALS HANDLING. By S. J. Koshkin. New York, John Wiley and Sons, 1932. 488 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $6.

Modern methods of, and equipment for, handling materials in factories. Such items as cranes, overhead transporters, trucks, conveyors, hoists, and coal and ash handlers are considered. Methods of handling different materials are explained, and the choice of equipment for any given purpose is discussed.

MUNICIPAL INDEX AND ATLAS. 9 ed., 1932. New York, American City Magazine Corporation. 601 pp., illus., diagrs., maps, charts, tables, 10 × 7 in., leather, $5.

This yearbook is a combined buyers' guide and manual of general information for city officials, state highway engineers, and others interested in public improvements. Its various sections are devoted to administration and planning, streets and roads, street cleaning, highway traffic, water supply, lighting, sewers and sewage disposal, garbage disposal, police and fire prevention, parks and playgrounds, airports, and municipal officers and their salaries.

NOMOGRAM, THE THEORY AND PRACTICAL CONSTRUCTION OF COMPUTATION CHARTS. By H. J. Allcock and J. R. Jones. London and New York, Isaac Pitman and Sons, 1932. 209 pp., diagrs., charts, tables, 9 × 6 in. cloth, $3.

A systematic treatment of the subject from the practical as well as the theoretical point of view. The authors discuss the general theory of nomograms and also give practical directions for making and using all classes of computation charts which have scientific or industrial usefulness. The book covers the field very satisfactorily and will be welcomed by calculators.

REGIONAL PLAN OF THE PHILADELPHIA TRI-STATE DISTRICT. Philadelphia, Regional Planning Federation of the Philadelphia Tri-State District. 1932. 589 pp., illus., diagrs., charts, maps, tables, 11 × 9 in., cloth. $10. (1 table-size map reproduction of the plan, 4½ × 5 ft.)

The Regional Planning Association, with the assistance of interested citizens and a large technical advisory committee of architects, engineers, and landscape architects, has for several years been studying the needs of Philadelphia, Camden, Trenton, Wilmington, and their environs. The resultant plan for developing the facilities for transportation, communication, power, sanitation, and recreation in this region are presented in this handsome volume, together with the reports upon which the plan is based.

SEWERAGE AND SEWAGE TREATMENT. By H. E. Babbitt. 4 ed. New York, John Wiley and Sons, 1932. 596 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth. $5.

This well known textbook provides in one volume a good treatment of the whole field, with a number of useful lists of references for further information. The new edition has been thoroughly revised, and the chapters on the quality of sewerage and sewage treatment rewritten. A chapter on industrial wastes and a collection of problems have been added.

SPECIFICATIONS AND METHODS OF TEST FOR REFRACTORY MATERIALS AND MANUAL FOR INTERPRETATION OF REFRACTORY TEST DATA, prepared by Committee C-8 on Refractories. Philadelphia, American Society for Testing Materials, 1932. 93 pp., diagrs., charts, tables, 9 × 6 in., paper, 50 cents.

The various publications of the society pertaining to the specification and testing of fire brick and other refractory materials are here brought together in convenient form.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Magazines in This Country and in Foreign Lands

Selected items from the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own files, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

BASCULE, GREAT BRITAIN. Poole Harbor Bridge, E. W. Gill. *Inst. Civ. Engrs.—Selected Eng. Papers*, No. 112, 1931, 11 pp. 1 supp. plate. Construction of two-leaf bascule bridge of 60-ft. clear span; total length, including approaches, is 329 ft.

BURMA. Bwetgyi Bridge, Burma, G. E. Scott, *Inst. Civ. Engrs.—Selected Eng. Papers*, no. 110, 1931, 8 pp., 1 supp. plate. Design and construction of highway bridge, over shifting river channel, consisting of 4 spans of 100 ft. each; sinking of foundation wells; use of guide banks.

DESIGN. Evolution of Art and Science in Our Bridges, A Memoir, J. A. L. Waddell. *Ass'n Chinese and Am. Engrs.—Journal*, vol. 13, no. 4, July 1932, pp. 1–16. Address on the evolution of bridge design and construction in the United States. (In English.)

MILITARY. Portable Steel Military Bridges, B. H. Bowley, Jr. *Military Engr.*, vol. 24, no. 137, Sept.–Oct. 1932, pp. 532 and 533. Discussion by W. G. Atwood and M. D. Kolyn, of paper previously indexed from issue of July–Aug. 1932.

OREGON. Design and Construction of St. Johns Bridge at Portland, Oregon, D. B. Steinman. *Franklin Inst.—Journal*, vol. 214, no. 4, Oct. 1932, pp. 377–412. Design and construction of suspension bridge having a main span 1,207 ft. long with a floor 205 ft. above navigable water; use of tall arched concrete viaduct piers reinforced with structural steel frames; use of arched steel towers 400 ft. high without conventional diagonal bracing; tests on scale elastic model; substitution of pre-stressed rope strands for conventional parallel wire cable construction.

PIERS, FOUNDATIONS. Bridge Foundations—I, H. E. Brooke-Bradley. *Structural Engr.*, vol. 10 (New Series), no. 10, Oct. 1932, pp. 417–426. Control of streams; relation of piers to flow; underground springs; shape of cutwaters; classification of soils; artificial foundations; piles; cofferdams; cylinder foundations; skin friction; screw cylinders; reinforced concrete caissons.

RAILROAD CROSSINGS, LOUISVILLE. Unusual Grade Separation Structure. *Ry. Age*, vol. 93, no. 12, Sept. 17, 1932, pp. 398–400. Three-span bridge built to carry tracks of the Kentucky and Indiana Terminal over Broadway in Louisville, Ky., is noteworthy as an example of the use of continuous construction to obtain least economical depth of girders for 60-ft. span between curb lines; total cost $782,000.

RIGID FRAME. Rigid Frame Bridge, W. A. Hill. *Civ. Eng. (Lond.)*, vol. 27, no. 314, Aug. 1932, pp. 40–43. Preliminary calculations for 100-ft. span structure.

SAN FRANCISCO-OAKLAND BAY. San Francisco-Oakland Bay Bridge. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932, pp. 457–460. Outline of $75,000,000 highway bridge project comprising two 2,310-ft. suspension spans, 500-ft. island tunnel, and 1,400-ft. cantilever; history of project; structural features; suspension span towers are 460 ft. high and provide 214-ft. shipping clearance; towers and piers are designed for earthquake forces of 7½ per cent of gravity; proposed man-hours of work by months.

STEEL TRUSS, DESIGN. Secondary Stresses in Bridge Trusses, S. Hogg. *Eng. Journal*, vol. 15, no. 10, Oct. 1932, pp. 464–466. Outline of simplified or approximate method which will give reasonably accurate results with small expenditure of time. Method is as follows: determine relative position of the ends of each member of the truss for loading under consideration; from these deflections compute moments at ends of each member, assuming ends to be fixed.

SUSPENSION, CONSTRUCTION. Erecting Small Highway Bridge. *Wire Eng.*, vol. 2, no. 1, July 1932, pp. 10–17. Construction of small highway bridge; having a main span of 170 ft. with a width of roadway of 11 ft.; designed to safely carry concentrated load produced by 15-ton loaded truck at midspan plus 25 per cent impact; principal dimensions governing cable erections and adjustment.

WOODEN, STANDARDIZATION. Committee VII—Wooden Bridges and Trestles. *Am. Ry. Eng. Ass'n—Bul.*, vol. 34, no. 347, July 1932, p. 18. Standardization and simplification of store stock and disposition of material reaching obsolescence, collaborating with other committees, and organizations concerned.

BUILDINGS

EXHIBITION BUILDINGS, CHICAGO. Hall of Science. Century of Progress Exposition. Details of Structure and Equipment, L. Skidmore. *Arch. Forum*, vol. 57, no. 4, Oct. 1932, pp. 361–366. Structural features of U-shaped building occupying an area of 400 by 700 ft.; types of floor, terrace, and roof construction designed for safety, economy, and easy demolition; architectural lighting; 12 pylons illuminated by means of neon tubes concealed by system of suspended coves.

OFFICE, CANADA. New Sun Life Head Office Building at Montreal, Que., G. D. O'Connor. *Can. Eng.*, vol. 63, no. 13, Sept. 27, 1932, pp. 5–10. Design and construction of the largest office building in Montreal, 400 ft. high, 23 office floors, covering two acres and containing 18,500 tons of steel; electrical equipment; plumbing system; mechanical ventilation system; refrigeration; steam station; elevators; security vault.

RECONSTRUCTION. Adding Stories to Old Concrete Buildings, H. Bittman. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932, p. 472. Adding 6 stories to a two-story concrete building in Seattle; steel rods placed around old concrete columns, stiffened by welding lacing bars and finally incased in concrete, carry load from new floors around, and not into, old columns.

STEEL, DESIGN. Steelwork for Buildings. *Structural Engr.*, vol. 10 (New Series), no. 10, Oct. 1932, pp. 434–442. Discussion of paper before Inst. Structural Engr., previously indexed from issue of June 1932.

CITY AND REGIONAL PLANNING

CITY PLANNING. Economic Side of Town Planning, D. P. Howells. *Inst. Mun. and County Engrs.—Journal*, vol. 59, no. 5, Aug. 30, 1932, pp. 356–367 (discussion) 368–374. Stability of land values; assistance to trade and industry; general arrangement of town plan; subdivision of land; roads and streets; open spaces; ribbon development; advantages; disadvantages.

DANZIG. Staedtebau in Danzig, Althoff. *Zentralblatt der Bauverwaltung*, vol. 52, no. 37, Aug. 24, 1932, pp. 433–440. Maps showing growth of city of Danzig since 1310; statistical data; zoning plans and plans of extensions.

CONCRETE

AGGREGATES, SPECIFICATIONS. Essential Requirements for Aggregate Specifications, S. C. Hollister. *Mich. Eng.*, vol. 51, issue 3, Sept. 1932, pp. 16–21. Review of essential requirements for fine and coarse aggregates.

CEMENT, LOW HEAT. Development of Low-Heat for Mass Concrete, R. W. Carlson. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932, pp. 461–463. Size of modern concrete dams and construction speed intensify problems of cracking; present cements generate high heat during hydration; modification of chemical composition retards and reduces heat rise; comparison of characteristics of major cement compounds; comparison of early and modern cement; interground silica cement; present trends.

CULVERTS, CONCRETE. Pneumatic Core System for Pipes and Culverts. *Commonwealth Engr.*, vol. 20, no. 1, Aug. 1, 1932, pp. 16–18. Description of construction process practiced in New South Wales, involving use of pneumatic rubber cores serving as superior form work in concrete culvert and pipeline construction; Australian rights to process are held by Concreters Ltd., 66 Pitt St., Sydney.

FORMS. Low Cost of Form Construction on Pacific Coast, C. H. Weitz. *Concrete*, vol. 40, no. 9, Sept. 1932, p. 12. Discussion of and supplementary information to paper by A. B. MacMillan entitled: "How to Save in Concrete Form Work," indexed in Engineering Index 1930, p. 428, from issues of from Jan. to Nov. 1930, inclusive; labor cost per square foot of contact surface.

LIGHT WEIGHT. Light-Weight Aggregates Available Over Wide Area. *Concrete*, vol. 40, no. 9, Sept. 1932, p. 13. Cinders as aggregate; burned shale or clay aggregates; processed slag aggregate; location of producing plants.

LOUISIANA. Proves Worth of Pre-Mixed Concrete to New Orleans Building Industry. *Pit and Quarry*, vol. 24, no. 13, Sept. 21, 1932, pp. 41 and 42. Methods and equipment at ready-mixed concrete plant of J. J. Clarke Co.; new batching plant consists of 2-compartment Blaw-Knox 150-ton steel bin with 20,000-lb. weighing batcher, etc.

MATERIALS HANDLING. Coordinating Materials Handling Equipment in Ready Mixed Concrete Plant, F. A. Westbrook. *Materials Handling and Distribution*,, vol. 8, no. 6, Sept. 1932, pp. 15 and 16. Central ready-mixed concrete plant plays an important part in reducing costs of construction work; methods and equipment used at Central Red-E-Mix Concrete Co., of Bridgeport, Conn.

MIXING. Proportion Aggregate for Concrete on Basis of Separate Sizes, G. W. Hutchinson. *Concrete*, vol. 40, no. 10, Oct. 1932, pp. 17 and 18. Various combinations of assorted sizes; special application in field of ready-mixed concrete; water-cement ratio law is practical; overcoming segregation during shipment.

PAINTING. Painting on Concrete Surfaces, F. O. Anderegg. *Am. Concrete Inst.—Journal*, vol. 4, no. 1, Sept. 1932, pp. 1–7. Report of Committee 407 compiled from information received from a large number of manufacturers, users, etc.; effect of factors arising from concrete and nature of its surface; painting materials used and best practice in their application to produce satisfactory decorative coatings; alkalies in concrete; efflorescent crystal pressure.

PROPORTIONING. Water Control of Dry Mixed Concrete, G. W. Gleeson. *Concrete Products*, vol. 41, no. 9, Sept. 1932, pp. 8 and 9. Study of dry-mixed concrete, or concrete having no slump; standard building units, cast stone, concrete pipe, silo staves, etc., are examples of dry-mixed concrete; manufacturers of concrete burial vaults and products having measurable slump must be governed by water-cement ratio in considerations involving their mixes.

RAILROAD CONSTRUCTION, CONCRETE. Committee VIII—Masonry. *Am. Ry. Eng. Ass'n—Bul.*, vol. 34, no. 347, July 1932, pp. 19 and 20. Revisions of specifications for portland-cement concrete, plain and reinforced.

READY-MIXED. Simplified Control of Ready-Mixed Concrete, D. V. Terrell. *Concrete*, vol. 40, no. 10, Oct. 1932, pp. 8, 9, and 20. Simple methods of designing mix; control and operation of plant without constant determinations of moisture in aggregate.

SLAG. Light Weight Slag Aggregate Now Produced in Chicago. *Rock Products*, vol. 35, no. 19, Sept. 24, 1932, p. 27; see also *Concrete Products*, vol. 41, no. 9, Sept. 1932, p. 11. Lightweight concrete used both in poured construction and in precast work; physical properties of material; practice of Chicago Waylite Aggregate Co., in processing blast-furnace slag.

SLIPWAYS, CONCRETE. Construction of Concrete Building Ways, J. T. Mathews. *Military Engr.*, vol. 24, no. 136, July–Aug. 1932, pp. 383 and 387. Design and construction of ways for Charleston Navy Yard consisted of reinforced-concrete structure 340 ft. long, 68 ft. wide for a length of 290 ft. from inboard end, and 24 ft. wide for a length of 50 ft. from outboard end; inspection and tests; cost data.

SPECIFICATIONS. Proposed New Federal Specifications for Concrete Aggregates. *Rock Prod-*

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Continued on page 12

ucts, vol. 35, no. 20, Oct. 8, 1932, pp. 17 and 18. Specifications for portland-cement concrete aggregates.

TESTING. Mechanics of Failure of Standard Concrete Test Specimens, F. N. Menefee. *Mich. Engr.*, vol. 51, no. 3, Sept. 1932, pp. 6–9. Mathematical analysis of mechanism of "diagonal shear," of "cone fracture," and "longitudinal splits."

WASHINGTON. Central Concrete Mixing Plant, Puget Sound Navy Yard, A. D. Hunter. *Am. Concrete Inst.—Journal*, vol. 4, no. 2, Oct. 1932, pp. 81–85. Layout and description of the equipment of a plant having a maximum capacity of 300 cu. yd. of concrete in 8-hour shift.

DAMS

CABLEWAYS. Record - Size Cableway for Hoover Dam. *Eng. News-Rec.*, vol. 109, no. 14, Oct. 6, 1932, pp. 408–410. Description of installation of 150-ton capacity and 1,200-ft. span, to handle penstock pipe and generating equipment, which will be by far the largest in the world; drop of 605 ft. between loading and unloading platforms; plant to be two-speed electrically operated; control system.

CEMENT, LOW-HEAT. Special Low-Heat Cement for Pine Canyon Dam. *Eng. News-Rec.*, vol. 109, no. 14, Oct. 6, 1932, pp. 410 and 411. Specifications for special cement whose cumulative heat of hydration must not exceed 65 cal. per gram of cement at the age of 7 days, and 80 cal. at 28 days.

CONCRETE. Thin Concrete Diaphragm Protects Ringedal Dam, C. F. Groener. *Eng. News-Rec.*, vol. 109, no. 17, Oct. 27, 1932, pp. 498–500. Frost-protection disintegration of Ringedal Dam at Hardanger, Norway, 35 m. high, due to percolation of water through its porous masonry, checked by construction of thin diaphragm of reinforced concrete, 20 cm. to 47 cm. thick, held 2 m. in front of dam by struts; construction operations; laboratory control; use of concrete with blast-furnace slag and diatomaceous earth admixtures.

CONSTRUCTION, CABLEWAYS. Aerial Cableways at Nag Hammadi Barrage, Upper Egypt, I. V. G. Freeman. *Inst. Civ. Engrs.—Selected Eng. Papers*, no. 120, 1931, 16 pp. Description of cableways used in the construction of the concrete barrage; 5 blondin cableways were erected, each with a span of 3,100 ft., crossing Nile above site; arrangement of load carriage; reliability; signaling.

COSTS. Unit Bid Summary. *West Construction News and Highways Bldr.*, vol. 7, no. 18, Sept. 25, 1932, pp. 544, 546, 548, 550, and 552. Unit costs bid on San Gabriel Dam No. 1, Los Angeles Flood Control District, also on street and road work in California, Arizona, Oregon, and Washington.

COVERED. Construction of Meriden Service Reservoir, A. C. Jack. *Civ. Eng.* (*Lond.*), vol. 27, no. 314, Aug. 1932, pp. 13–17. Construction of circular covered water supply reservoir of 10,000,000 gal. capacity, for the City of Coventry, England; internal diameter 280.5 ft.; normal depth 25.5 ft.; concrete roof supported on rings of groin arches of 24-ft. span, 2.75 rise.

EARTH, CALIFORNIA. Santiago Creek Earth-Fill Dam, H. L. Walton. *Military Engr.*, vol. 24, no. 136, July–Aug. 1932, pp. 357–361. Rolled dam of 130 ft. maximum height, 1,425 ft. long, located 11 miles east of Santa Ana, Calif.; upstream impervious section is clay and downstream pervious section gravel; reinforced-concrete open-channel spillway with capacity of 24,000 sec-ft.; gate tower; geology and hydrology; unit prices and quantities.

EXPANSION JOINTS. Contraction Joints of Pardee Dam Grouted a Second Time, F. W. Hanna. *Eng. News-Rec.*, vol. 109, no. 15, Oct. 13, 1932, p. 431. Further grouting to counteract continued cooling and shrinkage of Pardee Dam, described in article indexed in Engineering Index 1929, page 546; thermocouples placed in dam at about mid-height; 2-in. holes drilled at 20-ft. intervals, at angles of 45 deg. with faces of contraction joints, in all vertical joints in downstream face of dam and at elevations of approximately 50, 75, and 100 ft. below top, within middle half of upstream face.

HYDRAULIC FILL, HAWAIIAN ISLANDS. Beach Drainage Safeguards Alexander Dam, J. E. Cox. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932 pp. 466–469. Reconstruction of Hawaiian dam, 140 ft. high, which failed in 1930 during construction, completed by installing systems of drains in downstream beach section; collapse was due to local compacting of downstream beach section due to crushing of fragments composing it; performance of drains; experimental control; field checks.

RESERVOIRS, GROUTINGS. Clay Grouting at Madden Reservoir, F. H. Kellog. *Eng. News-Rec.*, vol. 109, no. 14, Oct. 6, 1932, pp. 395–399. Results of field and laboratory experiments showing feasibility of making cavernous and fissured rock ridge enclosing new Panama Canal reservoir impervious, by injecting clay slurry; drill-hole experiments; moisture-viscosity and moisture-time diagrams of clays of different moisture content; actual grouting results, costs, and advantages; objections. Bibliography.

SPILLWAYS, DESIGN. Effect of Reservoir-Area on Discharge of Overflow Weir, P. J. Robinson. *Inst. Civ. Engrs.—Selected Eng. Paper*, no. 118, 1931, 13 pp. Theoretical mathematical analysis including an outline of the graphical method for the computation of spillway length, taking into account the effect of temporary storage of water in the reservoir above the level of weir-sill.

WEIRS, APRONS. Causes and Prevention of Bed Erosion, A. D. Butcher and J. D. Atkinson. *Surveyor*, vol. 82, no. 2124, Oct. 7, 1932, p. 312. Abstract of paper to be brought forward for discussion at Institution of Civil Engineers; results of several years of experimentation at Hydraulic Research Station at Delta Barrage, near Cairo, Egypt, on principles of design of protective aprons at toe of weirs and dams, built on pervious foundation; authors advocate use of models for every major structure during process of design.

FLOOD CONTROL

FLOOD PROBLEMS. Some Aspects of Flood-Control Problem, C. E. Grunsky. *Military Eng.*, vol. 24, no. 136, July–Aug. 1932, pp. 336–343. Article based on Fogg Brackett Lecture, Princeton University, Jan. 1932; comparative discussion of formulas of flood run-off.

GERMANY. Die Eindeichung der Stadt Neuwied, Muenster. *Zentralblatt der Bauverwaltung*, vol. 52, no. 40, Sept. 14, 1932, pp. 469–477. Design and construction of a levee system for the protection of the City of Neuwied, on the Rhine River, against destructive floods; features of masonry dikes and pumping plants.

INDUS RIVER. Shyok Glaciers and Indus Floods, J. M. Lacey. *Engineer*, vol. 154, no. 4005, Oct. 14, 1932, pp. 372–374. History of floods of this region; great flood in Indus in 1841 now ascribed to earthen dam formed across the river by fall of spur of Nanga Parbat; 1929 flood; flood of July 1932; experts find difficulty in forming conclusion regarding periodicity of advance and retreat of glaciers.

HYDRAULIC ENGINEERING

HYDRAULIC MODELS. Research at Waterways Experiment Station, H. D. Vogel. *Military Engr.*, vol. 24, no. 136, July–Aug. 1932, pp. 331–335. Review of hydraulic-model studies; backwater in Illinois River; Dam No. 37 Ohio River; effects of cut-offs on Mississippi River; Eagle Lake Levee extensions; erosive effects on railroad embankments; soil and sediment investigations; Walkers Bar; Ohio River; St. Lucie Canal.

WEIRS, HYDRAULIC MODELS. Shannon Power Development Scheme. *Civ. Eng.* (*Lond.*), vol. 27, no. 314, Aug. 1932, pp. 18–24. Model experiments to determine the design of the overflow or waste channel in intake at power station.

HYDRO-ELECTRIC POWER PLANTS

UNITED STATES. Fifteen Mile Falls Lower Development on Connecticut River in Towns of Monroe, N.H., and Barnet, Vt., C. R. Bliss. *Boston Soc. Civ. Engrs.—Journal*, vol. 19, no. 7, Sept. 1932, pp. 373–404 (discussion) 404–415. Design and Construction of upper and lower power plants of 145 and 170-ft. average gross heads with nominal capacities of 105,000 kw. and 140,000 kw., respectively, including concrete gravity dam of 98 ft. max height; electrical equipment; models and laboratory investigations; efficiency tests; metering equipment; list of equipment.

WASHINGTON. Ariel Hydro - Electric Project, L. Griswold and E. F. Pearson. *Military Engr.*, vol. 24, no. 137, Sept.–Oct., 1932, pp. 453–455. Construction of Ariel Project of Inland Power and Light Company on the Lewis River, tributary to the Columbia, in Cowlitz and Clark counties, Washington, comprising a dam of the thin arch type 313 ft. high; 4 penstocks of inside diameter of 15.5 ft.

HYDROLOGY, METEOROLOGY, AND SEISMOGRAPHY

HURRICANES, PUERTO RICO. Lessons from Hurricanes in Puerto Rico, M. Font. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932, pp. 470 and 471. Structures wrecked in wind of Sept. 27 were of inadequate construction; anemometer again destroyed; design changes suggested for structures in hurricane areas.

INLAND WATERWAYS

MISSISSIPPI. Changes in Length of Lower Mississippi, L. E. Lyon. *Military Engr.*, vol. 24, no. 137, Sept.–Oct. 1932, pp. 458–462. Study of maps and surveys since 1857, showing the total increase in length of more than 50 miles in 34 years.

IRRIGATION

EASTERN UNITED STATES. Irrigation Practice in Eastern States, F. E. Staebner. *Agric. Eng.*, vol. 13, no. 10, Oct. 1932, p. 264. Review of spray irrigation and subirrigation practice in Eastern United States, with special reference to Florida; use of spray irrigation for protection against frost damage. Before Am. Soc. Agric. Engrs.

LAND RECLAMATION AND DRAINAGE

CULVERTS, CONSTRUCTION. Pressures Required for Jacking Corrugated Pipe Are Registered. *Eng. and Contracting*, vol. 71, no. 9, Sept. 1932, pp. 209 and 210. Jacking of 118 ft. of corrugated pipe in King County, Washington; installation several feet below water table intercepted quicksand stratum midway; pressures required.

MATERIALS TESTING

CONCRETE. Los Angeles Makes Concrete Pavement Tests, H. P. Cortelyou. *West Construction News and Highways Bldr.*, vol. 7, no. 18, Sept. 25, 1932, pp. 529–531. Effect of proportioning and placing methods on concrete strength studied by means of pavement cores taken over three-year period.

EMULSIONS. New Process in Testing Bituminous Emulsions, K. Neubronner. *Roads and Road Construction*, vol. 10, no. 117, Sept. 1, 1932, p. 281. Principle of new process: absorbent material, such as cloth, is soaked in emulsion and then dried in moderate temperature; directions for testing bituminous emulsions with emulsifying matter indissoluble in water.

WELDS, STRENGTH. Strength of Arc-Welded Joints, F. R. Freeman. *Am. Welding Soc.—Journal*, vol. 11, no. 6, June 1932, pp. 16–24. Effect of variation in size and length of fillet, thickness and width of plates joined, etc.

PORTS AND MARITIME STRUCTURES

AFRICA. Le port de Dakar ses origines, ce qu'il est, son Avenir, A. Boucher. *Annales des Ponts et Chaussees*, vol. 1, no. 1, Jan.–Feb. 1932, pp. 104–141. History and description of Port of Dakar, in French Senegal; features of breakwaters and sea walls; plans for extension of port; statistical data on commerce of port.

CORPUS CHRISTI, TEXAS. Port of Corpus Christi, L. M. Adams. *Military Engr.*, vol. 24, no. 136, July–Aug. 1932, pp. 410–415. Recently opened water port; cotton-compress facilities; administration of port; administrative organization; insurance.

JETTIES, BORDEAUX, FRANCE. Transatlantic Passenger Jetty at Port of Bordeaux, B. Cunningham. *Engineering*, vol. 134, no. 3482, Oct. 7, 1932, pp. 405–409, 2 supp. plates. Jetty 125 ft. wide to carry four lines of track with double-story maritime railway station; formed of five longitudinal blocks each 60 m. long carried on four sets of cylinder piers; cylinder-sinking method consisted of installation of high-powered pumps supplying air to base of tubes inserted in cylinder to be evacuated; cylinders are of reinforced concrete, made with alumina cement.

MOORING EQUIPMENT. Hamburger Seeschiffdalben, P. Brands. *Werft Reederei Hafen*, vol. 13, no. 16, Aug. 15, 1932, pp. 243–245. Hamburg mooring posts; examples of 8, 16, and 24-pile posts, and of post chains.

PACIFIC COAST. Proper Economic Function of Small Ports of Pacific Coast, E. Gribble. *Ry. and Mar. News*, vol. 29, no. 9, Sept. 1932, pp., 6–9 (discussion) 9–12. Types of ports; high rate cargo available; competition favors larger ports. Before Ass'n Pac. and Far East Ports.

PIERS, CONSTRUCTION. Notas sobre el clavado de tablestacas en el puerto de San Antonio, C. V. Cruchaga. *Anales del Instituto de Ingenieros de Chile*, vol. 32, no. 2, Feb. 1932, pp. 61–65. Notes on the driving of sheet piling at the port of San Antonio in Chile; jetty 366 m. long with 10-m. penetration, with Larssen No. 4 and 5 type of sheet piling; dimensional data and details of construction.

ROADS AND STREETS

BITUMINOUS. Note au sujet de recherches récentes sur l'amelioration des goudrons pour routes au moyen de "fillers" charbonneux, P. LeGavrian. *Annales des Ponts et Chaussees*, vol. 1, no. 1, Jan.–Feb. 1932, pp. 5–10; see also *Journal des Usines a Gaz.*, vol. 56, no. 16, Aug. 20, 1932, pp. 431–437. Report on recent British and French research on treatment of coal tars with bituminous fillers to make them suitable for use as road materials.

CALCIUM CHLORIDE. Calcium Chloride for Road Maintenance, H. F. Clemmer. *Contract Rec.*, vol. 46, no. 38, Sept. 21, 1932, pp. 1064–1066. Studies of three types of roads; action of calcium chloride; value of calcium chloride; applying calcium chloride.

CANADA. Canadian Good Roads Convention, W. C. Coo. *Can. Engrs.*, vol. 63, no. 12, Sept. 20, 1932, pp. 68–94D. Verbatim report of proceedings, including the following papers: Highways in Province of Quebec, J. L. Boulanger; Calcium Chloride for Maintenance, H. F. Clem.

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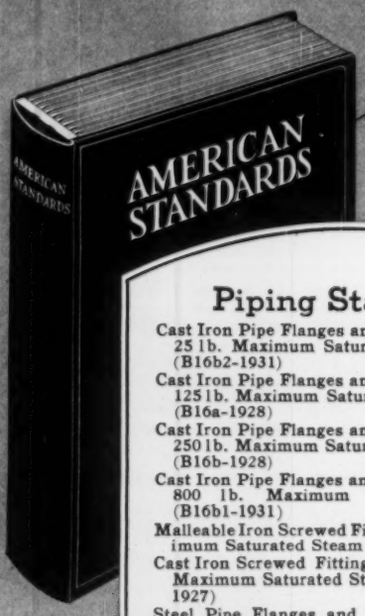

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mer; Maintenance of Gravel Roads, R. W. McColough; Maintenance of Gravel Roads, B. H. Kinghorn; Highways for Present Needs, G. E. Martin.

CITIES. What Kind of Street Pavements Do Cities Prefer? E. M. Fleming. *Concrete*, vol. 40, no. 9, Sept. 1932, pp. 8–10. Results of survey of U.S. Bureau of Mines, covering the period 1925–1929 inclusive and showing paving trends in 201 cities; strong trend toward concrete streets.

CONCRETE. Deformation of Concrete Road-Slabs, R. G. C. Batson and S. A. Woods. *Inst. Civ. Engrs.—Selected Eng. Paper*, no. 108, 1931, 20 pp. Report on tests by Ministry of Transport (Roads Department) of deformation of concrete slabs used in construction of the experimental section of a new by-path road; observations on tilting of whole foundation; movements of temporary nature due to effects of temperature and weather; permanent deformations spread over long periods.

CONNECTICUT. Development of Feeder Roads in Connecticut, A. W. Bushnell. *Highway Engr. and Contractor*, vol. 41, no. 2, Aug. 1932, pp. 20–23. Legal, financial, and engineering aspects of development.

CURVES. Highway Curve Design, H. Criswell and R. E. Harris. *Roads and Road Construction*, vol. 10, no. 116, Aug. 1, 1932, pp. 232–234 (discussion) 239. Deflections for transitions on reverse curves of 5 and 8 deg.; longitudinal gradients. (Concluded.)

EARTH. Treatment of Earth and Clay Roads with Bituminous Materials, P. Hubbard. *Can. Engr.*, vol. 63, no. 11, Sept. 13, 1932, pp. 19, 20, and 46. Construction of bituminous surfaces; road-mix, machine-mixed, penetration, hot-mix and cold-laid pre-mixed pavements.

EUROPE. New Type of Cement Road in Use in Europe, O. Graf. *Eng. News-Rec.*, vol. 109, no. 14, Oct. 6, 1932, pp. 400–401. Experience with stone roads penetrated with bituminized-cement grout, which in the United States is known as Hassam pavement; description of machine at Technische Hochschule, Stuttgart, used in testing bituminized-cement road.

EXPERIMENTAL. Experimental Road Surfacing at Garfield, Victoria, F. West. *Commonwealth Engr.*, vol. 20, no. 1, Aug. 1, 1932, pp. 19–24. Construction and cost of one-half mile of experimental pavement for testing the possibilities of bituminous surface treatment of lower-type road surfaces; distillation tests of solvents and mixtures.

MAINTENANCE AND REPAIR. Repaving Cuts in Concrete Pavements, F. D. Woodruff. *Pub. Works*, vol. 63, no. 9, Sept. 1932, pp. 35–39. Previously indexed from *Eng. News-Rec.*, Apr. 14, 1932.

MATERIALS. Road Material Survey Methods, D. G. Runner. *Roads and Streets*, vol. 75, no. 10, Oct. 1932, pp. 427–432. Low-cost roads; materials to be investigated; classification of rock and of sand-gravel deposits according to type; equipment for material survey; primary investigation; examination of sites; sampling; test pits; typical field notebook record sheet and detailed description of material site.

MORRIS COUNTY HIGHWAY. Cement—Macadam Road Gets New Trial, W. C. Spargo. *Eng. News-Rec.*, vol. 109, no. 15, Oct. 13, 1932, pp. 437 and 438. Experience with so-called "Hassam pavement"; grouted stone surface 18 ft. wide and 6 in. thick constructed on Morris County Highway in New Jersey at a low cost; core-drill test results; crack control.

NEW HAMPSHIRE. New Hampshire Traffic Survey, L. E. Peabody. *Pub. Roads*, vol. 13, no. 8, Oct. 1932, pp. 131–136. Results of the 1931 survey of highway traffic upon trunk-line, State-aid, and town road systems of New Hampshire; comparison of 1926 traffic forecast with actual traffic in 1931, by specific routes.

RAILROAD CROSSINGS, ELIMINATION. New Approach to Grade Separation Problem. *Ry. Age.*, vol. 93, no. 15, Oct. 8, 1932, pp. 494–497. Committee at Detroit, representing railroads, property holders, and public, shows how grade separation can provide means of enhancing rather than depressing the value of adjacent property and afford an opportunity for marked improvement in effectiveness of railways; points way to decreased outlays for such projects.

SWITZERLAND. La route en beton en Suisse, R. Dutron. *Annales des Travaux Publics de Belgique*, vol. 33, no. 3, June 1932, pp. 391–401. Review of concrete road construction practice of Switzerland with examples from recent jobs.

SEWERAGE AND SEWAGE DISPOSAL

ANALYSIS, SAMPLING. Automatic Sewage Sampler, C. E. Keefer. *Water Works and Sewerage*, vol. 79, no. 9, Sept. 1932, pp. 315 and 316. Electrically operated machine, collecting samples at three depths of sewage stream, used by Bureau of Sewers of Baltimore, Md.

EQUIPMENT. Mechanical Equipment in Sewage Treatment Works—IV, A. P. Folwell. *Pub. Works*, vol. 63, no. 9, Sept. 1932, pp. 12–14. Functions of sedimentation tanks; recent types of scrapers, sludge collectors, screens, and other sedimentation tank equipment.

HOLLAND. Sewage Treatment in Holland, W. Rudolfs. *Mun. Sanitation*, vol. 3, no. 9, Sept. 1932, pp. 367–369. Review of Dutch practice; slaughter-house waste treatment plant at Beverwyk; treatment of segregated industrial wastes; modern plants.

ILLINOIS. Operating Results of Five Sewage Treatment Plants in Illinois, H. E. Hudson, Jr. *Water Works and Sewerage*, vol. 79, no. 9, Sept. 1932, pp. 305–310. Survey of operating conditions of sewage treatment works of Sanitary Districts of Bloomington and Normal, Decatur, Elgin, Springfield, and Urbana-Champaign; four of plants have Imhoff tanks and trickling filters; fifth is activated sludge plant; bio-chemical oxygen demand of raw sewage; foaming troubles; settling tank efficiencies; loadings and efficiencies of trickling filters; gas collection. Bibliography.

JAPAN. Advanced American Practice Followed in Japanese Sewage-Treatment Plant, J. D. Hitch. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932, p. 469. Features of new sewage disposal plant for the city of Kyoto, having a population of 760,000; combined activated-sludge and separate-sludge digestion with mechanical equipment throughout.

NEW JERSEY. Eight Years' Operation of Passaic Valley Sewer, J. R. Van Duyne. *Eng. News-Rec.*, vol. 109, no. 15, Oct. 1932, pp. 440–442. Achievements of organization serving 22 communities; oxygen tests of Passaic River show that pollution has been greatly relieved; costs of operation outlined.

PRINCETON, N.J. Consolidating Sewage Disposal in Princeton, N.J. *Am. City*, vol. 47, no. 4, Oct. 1932, pp. 67–70. Six old plants, with attendant pollution, eliminated by new trunk sewer and one large plant; estimated quantities and unit prices.

SLUDGE. Non-Biological Sewage and Sludge Treatment, W. Rudolfs. *Pub. Works*, vol. 63, no. 9, Sept. 1932, pp. 23 and 24. Outline of method involving the use of displaceable tanks filled with slag, through which coarse-screened sewage is filtered upward, and incinerating adhering sludge in specially constructed calciner; cost estimates.

SLUDGE DIGESTION. Heat and Energy Relations in Digestion of Sewage Solids—II, G. M. Fair and E. W. Moore. *Sewage Works Journal*, vol. 4, no. 3, May 1932, pp. 428–443. Mathematical formulation of course of digestion; experimental apparatus and procedure; choice of gas production as yardstick of digestion; basic observations; concept of reaction velocity; comparison of observed and computed gas production; two-stage formulation; rate of digestion; time of digestion.

STRUCTURAL ENGINEERING

BEAMS, DESIGN. Checking Design of Rectangular Timber Beams, C. K. Clausen. *Eng. News-Rec.*, vol. 109, no. 16, Oct. 20, 1932, p. 471. Fundamental formulas for quick checking of design of rectangular timber, joints, beams, and girders; table of section modulus values of rectangular timber beams.

BRICK, REINFORCED. Brick Walls Without Foundations, W. R. McCaffrey. *Contract Rec.*, vol. 46, no. 43, Oct. 26, 1932, pp. 1221–1223, and 1227. Reinforced brick masonry in 4-in. walls lowers estimated wall cost by 20 per cent; research; test of strength.

BRIDGES. Bridge and Structural Engineering Congress, Paris. *Inst. Mun. and County Engrs.—Journal*, vol. 59, no. 7, Sept. 27, 1932, pp. xviii, xxi, xxii, and xxiv. (2 cards—card 1.) Abstracts of papers. Rectangular Slabs Supported on All Sides, W. Gehler; Welding in Steel Structural Work, T. Godard; Welded Steel Structures, Kommerell; Combination of Riveted and Welded Connections, H. Dustin; Large Girder Bridges in Reinforced Concrete, H. Lossier. (2 cards—card 2.) Large Girder Bridges in Germany, H. Spangenberg; Girder Bridges in Hungary, M. Gombos; Development of Statics of Reinforced Concrete with Regard to Properties of Material Used, F. Campus; Elasticity, Plasticity, and Shrinkage, O. Faber.

STATICALLY INDETERMINATE STRUCTURES, SAFETY FACTOR. Die Bestimmung des Sicherheitsgrades einfach statisch unbestimmter Fachwerke, E. Melan. *Zeit fuer Angewandte Mathematik-und Mechanik*, vol. 12, no. 3, June 1932, pp. 129–136. Theoretical mathematical discussion of determination of safety factory of statically indeterminate frameworks with one redundant member.

TUNNELS

CONSTRUCTION, SHOVELS. Electric Shovels Handle Tunnel Muck at Hoover Dam, R. W. McNeill. *Construction Methods*, vol. 14, no. 10, Oct. 1932, pp. 17–19. Methods of driving diversion tunnels; control of mucker motors consists of three-pole non-fused safety switch, of quick-make, quick-break type with Deion arc quenchers; equipment of Westinghouse design.

HOOVER DAM PROJECT, TUNNELS. Excavation of Diversion Tunnels for Hoover Dam, W. R. Nelson. *Reclamation Era*, vol. 23, no. 9, Sept. 1932, pp. 158 and 159; see also *Explosives Engr.*, vol. 10, no. 9, Sept. 1932, pp. 267–272. Excavation of four diversion tunnels, each 56 ft. in diameter, having an average length of 4,000 ft.; adits and pilot bores; drilling jumbo; trimming operations.

VEHICULAR, VENTILATION. Ventilation of East Boston Traffic Tunnel, A. A. Berestneff. *Heat and Vent.*, vol. 29, no. 9 Sept. 1932, pp. 38–40. Ventilation equipment of vehicular tunnel having a total length of 6,150 ft., maximum depth of roof below mean low water 54 ft., and outside diameter of circular cross section 31 ft.; ventilation buildings and fans.

WATER SUPPLY TUNNELS, CONSTRUCTION. Pumps Speed Grouting of 20-Mile Tunnel Under New York, A. S. Park. *Compressed Air Mag.*, vol. 37, no. 9, Sept. 1932, pp. 3922–3925. New methods prove successful in sealing the huge bore which will augment the distribution of water; 19 circular shafts from one to two miles apart sunk to tunnel line; 29 headings opened from shaft bottoms; shafts lined with concrete will comprise parts of permanent structure; details of equipment, ventilation, and compressed-air systems.

WATER PUMPING PLANTS

GREAT BRITAIN. Surbiton Pumping Station of Metropolitan Water Board. *Engineering*, vol. 134, no. 3484, Oct. 21, 1932, pp. 465–469. Remodeling of old station by conversion of existing plant and buildings to modern requirements in stages; turbines are of impulse type, having nine single stages with one two-row velocity wheel; pumps supplied by Worthington-Simpson are of double-suction, single-impeller, volute type; booster pumps of same type.

WATER TREATMENT

AMMONIA CHLORINE. Round Table. *Water Works Eng.*, vol. 85, no. 20, Oct. 5, 1932, pp. 1222–1224. Experiences with chloramine treatment; practical discussion of experience by water-works superintendents; ratio of each chemical used; installation giving best possible results.

FILTRATION PLANTS, CANADA. Unusual Features in Oshawa Filtration Plant, F. A. Dallyn. *Contract Rec.*, vol. 46, no. 37, Sept. 14, 1932, pp. 1031–1036. Description of new filtration plant with capacity of 6 m.g.d., designed to replace worn-out filters, showing adaptation of existing structures, improved piping arrangement, flexible control system, and careful provision for expansion at minimum expense; cost $25,900 per m.g.d.

SPAIN. El problema de la filtracion de aguas en las ciudades, F. Bastos Mora. *Ingenieria y Construccion*, vol. 10, no. 114, June 1932, pp. 309–312. Problem of water filtration for cities; details of plant at city of Valencia, Spain.

TASTE AND ODOR REMOVAL. Removal of Tastes and Odors in Filtered Water at Newport News, E. F. Dugger. *Water Works Eng.*, vol. 85, no. 19, Sept. 21, 1932, pp. 1179–1180. Use of activated carbon, following experiments at Suffolk, Va., makes water free from troubles caused by algae. Before Va. Water and Sewage Works Ass'n.

WATER WORKS ENGINEERING

CEYLON. Colombo's Water System, W. Buchler. *Water Works Eng.*, vol. 85, no. 19, Sept. 21, 1932, pp. 1126 and 1127. Description of water works of tropical city having a population of 300,000, including storage reservoir, distribution system with total mileage of 257 street standpipes, etc.

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